Attachment 2

Flaw Fracture Mechanics, Corrosion, and Loose Parts Evaluations for One Cycle Relief (DAR-MRCDA-15-6-NP)

Note: This attachment consists of a non-proprietary version of the Westinghouse Electric Corporation report DAR-MRCDA-15-6, *Palo Verde Unit 3 RCS Cold Leg Alloy 600 Small Bore Nozzle Repair.*

WESTINGHOUSE ELECTRIC COMPANY LLC

Palo Verde Unit 3 RCS Cold Leg Alloy 600 Small Bore Nozzle Repair

Prepared for Arizona Public Services

By Westinghouse Electric Company LLC

DAR-MRCDA-15-6-NP

Revision 1

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RECORD OF REVISIONS

Rev	Date	Revision Description
0-A	April 14, 2015	Preliminary Issue
0	April 17, 2015	Original Issue
1	See EDMS	Address customer editorial comments

Portions of this report contain proprietary information. Proprietary information is identified and bracketed. For each of the bracketed sections, the reasons for the proprietary classification are provided using letters superscripted letters “a” and “c”. These letters stand for:

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Table of Contents

1.0 Introduction

1.1 Background

During the 3R18 spring 2015 refueling outage at Palo Verde Nuclear Generating Station (PVNGS) Unit 3, visual examinations of the reactor coolant pump (RCP) suction safe end revealed evidence of leakage in the annulus between the outer surface of the Inconel 600 instrument nozzle and the bore on the suction safe end. The most likely location of the flaw(s) is in the primary water stress corrosion cracking (PWSCC)-susceptible Alloy 82/182 weld and Inconel 600 instrument nozzle, along their fusion line inside the safe end bore. The Alloy 600 instrument nozzle is attached with a partial penetration weld to the inside of the RCP suction safe end.

The "half-nozzle" repair method will be used to replace a portion of the Alloy 600 one-inch instrument nozzle. The repair will be made with an Inconel 690 PWSCC-resistant material half-nozzle, which will be attached to the Palo Verde Unit 3 RCP suction safe end outside diameter. This is an alternative to the ASME Section XI [1] requirement to correct the observed leakage. For the half-nozzle repair, the instrument nozzle is severed on the outside of the RCP suction safe end. The remaining lower portion of the instrument nozzle is removed by boring into the suction safe end. The removed portion of the Alloy 600 instrument nozzle is then replaced with a section (half-nozzle) of a more PWSCC-resistant Alloy 690 material, which will then be welded to the outside surface of the suction safe end using a 52M weld filler (see Figure 1-1). The inner portion of the original instrument nozzle, including the partial penetration weld, is left in place.

The half-nozzle repair has been successfully implemented on 63 Alloy 600 small-bore reactor coolant system hot leg nozzles (i.e., pressure taps, sampling line, and resistive temperature device thermowell nozzles) for Palo Verde Units 1, 2, and 3 [5 and 14]. Additionally, the half-nozzle method has been used at many other Combustion Engineering (CE) designed nuclear steam supply system plants.

Westinghouse has previously performed a technical justification and a fracture mechanics investigation into the feasibility of small diameter Alloy 600/690 half-nozzle repairs in WCAP-15973-P-A [2] and report CN-CI-02-71 [20]. The NRC has issued a final safety evaluation (SE) [3] that found WCAP-15973-P to be acceptable for referencing in licensing applications for CE designed pressurized water reactors as long as information required by the SE in is submitted as a relief request. The NRC SE [3] is incorporated into WCAP-15973-P-A [2], and this WCAP report was submitted to the NRC [16]. The flaw evaluation performed in this report will follow guidance from the technical basis and the NRC SE to demonstrate that a flaw(s) in the partial penetration weld will not grow to an unacceptable size in the suction safe end base metal, for up to 18 months of operation.

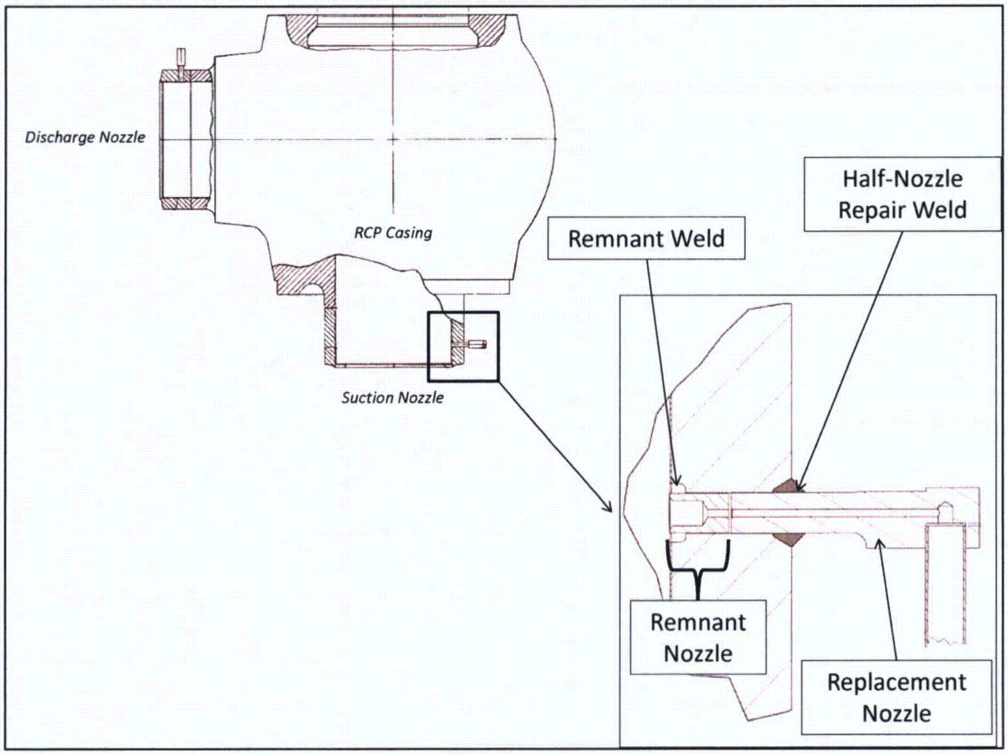


Figure 1-1: RCP Instrumentation Nozzle Repair Schematic

1.2 Purpose

The purpose of this report is to demonstrate the acceptability of the half-nozzle repair for the flawed RCP suction safe end instrument nozzle at Palo Verde Unit 3 based on a the following assessments:

1. corrosion evaluation [17]
2. ASME Section XI crack growth evaluation [17]
3. stress corrosion cracking assessment [17]
4. ASME Section III, Class 1 design analysis [15] and Code Reconciliation [19]
5. loose parts [18]

The flaw evaluation will demonstrate that any flaws in the penetration weld that remain after the half-nozzle repair will not grow to an unacceptable flaw size into the suction safe end carbon steel metal within the next cycle of operation (18 months). The fracture mechanics justification will be consistent with revision 1 of Relief Request 31, which was previously submitted and approved for the Palo Verde Units 1, 2, and 3 small-bore hot leg Alloy 600 nozzles [5 and 14].

A detailed ASME Section III, Class 1 design analysis is performed to design the replacement weld and associated new half-nozzle. The evaluations consider the primary stress, secondary stress, and fatigue usage factors in the replacement nozzle and weld. The evaluations also consider the change in the Class 1 pressure boundary.

A loose parts evaluation is performed to evaluate the effect that a postulated loose weld fragment(s) of the instrument nozzle partial penetration weld might have on a RCS system, structure, or component (SSC).

2.0 Applicability and Scope

The evaluations performed in this report are applicable to the PVNGS Unit 3 RCP 2A suction safe end instrument nozzle half-nozzle repair. The conclusions are applicable to a life of 18 months of operation.

3.0 General Corrosion Assessment

According to WCAP-15973-P-A [2], the crevices between the safe end bore and the instrument nozzle material will fill with borated water if a half-nozzle replacement/repair is implemented. When used as primary pressure boundary materials, carbon and low alloy steels are clad with corrosion-resistant materials (generally weld-deposited stainless steels) to isolate these materials from the primary coolant, thereby minimizing corrosion and corrosion product release to the coolant. The inside diameters of holes, such as those used for instrumentation nozzles, are not clad because, in the as-built condition, they are not exposed to borated water. During the time when the plant returns to operation from a shutdown condition (i.e., refueling), the crevice region may be filled with aerated water. The oxygen in the water will be consumed by corrosion of the steel; however, the corrosion rate will be high for the relatively short time when the temperature is at a low-to-moderate level. When the plant is operating, the crevice region will be de-aerated, and the corrosion rate is much less than that during the time immediately after startup.

<u>Maximum Allowable Bore Size</u>

The first step in the corrosion evaluation is the determination of the allowable increase in the diameter of the carbon steel nozzle bore. The allowable increase in the diameter (because of corrosion) was determined by subtracting the original bore diameter from the maximum allowable diameter. The maximum allowable hole size was determined in Section 2.4 of WCAP-15973-P-A [2] based on (1) the reduction in the effective weld shear area, and (2) the required area of reinforcement for the nozzle bore holes.

A value of [ ]^{a,c} inches of corrosion allowance was determined for the hot leg nozzle per A-CEOG-9449-1242 [4], which is Reference 12 of the WCAP-15973-P-A. Westinghouse Calculation CN-MRCDA-15-13 [15] determined that the actual Palo Verde Unit 3 suction safe end nozzle repair corrosion allowance would be larger than the hot leg nozzle corrosion allowance of [ ]^{a,c} inches. For conservatism, a corrosion allowance of [ ]^{a,c} inches was used herein for the Palo Verde Unit 3 suction safe end for the small Alloy 600 nozzle repair. The allowable diametrical hole increase of [ ]^{a,c} inches can be compared to the corrosion growth of the bore hole calculated for 40 years, as shown below.

Therefore, the hot leg nozzle corrosion allowance can be conservatively used for the RCP suction safe end. Similar trends for the other applications of fracture mechanics (i.e., flaw stability and crack growth), as described later in this report, will also demonstrate that the hot leg nozzle evaluations performed for Palo Verde Unit 3 in WCAP-15973-P-A [2] and the relief requests [4 and 15] are bounding for the RCP suction safe end bore region.

General Corrosion Rate

The corrosion rate for a carbon steel material (such as that of SA-508, Class 1) for the Palo Verde Unit 3 RCP suction safe end is provided in [2]. The corrosion rate in [2], applicable to the half-nozzle crevice region, is provided for three separate operating conditions: full power operation, startup mode (assumed to be at intermediate temperature with aerated primary coolant), and refueling mode (100°F with aerated primary coolant). The corrosion rates for each mode of operation are shown in Table 3-1 in mils per year (mpy). The percentage of time spent in each mode of operation based on [2] is also shown.

Arizona Public Service (APS) has committed to track the time at cold shutdown in the previous relief requests for hot leg Alloy 600 small-bore nozzle repairs [5] in order to provide assurance that the allowable hole diameter is not exceeded over the life of the plant. The case herein for 18 months is more than sufficient, as demonstrated below. Based on a review of Palo Verde Unit 3 operation data, the percentage of time spent in startup and cold shutdown conditions is bounded by the values used in [2].

Table 3-1: Corrosion Based on Mode of Operation

Mode of Operation	Growth Rate [2]	Percent Time in Mode [2]
Normal Operations	0.4 mpy	88%
Startup Conditions	19.0 mpy	2%
Cold Shutdown Conditions	8.0 mpy	10%

An overall corrosion rate is then determined based on the corrosion rates of the individual operating modes and the percentage of time spent in each mode. Using Table 3-1, the calculated corrosion rate (CR) for Palo Verde Unit 3 is:

$$CR = (0.88)(0.4 \text{ mpy}) + (0.02)(19.0 \text{ mpy}) + (0.10)(8.0 \text{ mpy}) = 1.53 \text{ mpy}$$

General Corrosion for 40 Years

For a conservative operation period of 40 years, the total corrosion of the nozzle bore would be:

Corrosion = (1.53 mpy)(40 years) = (0.00153 in/yr)(40 yrs)

= 0.0612 inches (radially, relative to penetration)

= 0.1224 inches (diametrically, relative to penetration)

As previously discussed, the allowable increase in hole diameter to the Palo Verde Unit 3 instrumentation nozzle bore is [ ]^{a,c} inches. Since the expected corrosion in 40 years is only 0.1224 inches diametrically, the diameter of the bore would remain acceptable beyond the next 40 years of operation.

4.0 Stress Evaluation and Transient Consideration

In [6, 20], for the technical basis for the hot leg half-nozzle repairs, postulated bounding flaws encompassing the entire partial penetration weld at small-bore penetration welds in the hot leg piping were assessed for flaw growth and flaw stability as specified in ASME Code Section XI for a plant life of 40 years. This is the basis for the WCAP-15973-P-A allowable flaw size and crack growth evaluations in [2]. These evaluations demonstrated that the postulated bounding flaws, which could have been left in place in the weld remnant after small-bore nozzle repairs, are acceptable. The small-bore instrument nozzle repairs evaluated for the hot leg are similar to the Palo Verde Unit 3 RCP suction safe end small-bore instrument nozzle repair. Any differences will be assessed herein to justify that the fracture mechanics evaluation performed for the hot leg nozzle repair would bound the RCP suction safe end small-bore instrument nozzle repair for the next 18 months of plant operation.

The weld size and bore diameter used in the hot leg half-nozzle repair evaluation are similar to that of the Palo Verde Unit 3 instrumentation nozzle half-nozzle repair in the suction safe end. The thickness used in the hot leg nozzle repair evaluation is 3.75 inches, as compared to the 3.00-inch thickness for the RCP suction safe end for Palo Verde Unit 3. This difference is evaluated in Section 5.0 of this report, and is shown to have an insignificant impact on the fracture mechanics analysis.

4.1 Thermal Transient Evaluation

The RCP suction safe end transients are the same as the cold leg transients documented in [7]. Based on [8], the usage factor for the hot leg piping is [ ]^{a,c} and the usage factor for the cold leg piping is [ ]^{a,c}. These usage factors are sufficiently small, and the difference between the two usage factors is considered to be insignificant; therefore, the transient effects on the RCP suction safe end are expected to be similar to those on the hot leg.

Based on a comparison of the hot leg transient definitions in [7] and the RCP nozzle transients in [9], all transients except for the Loss of Secondary Pressure (faulted condition) transient are more severe and limiting for the hot leg than for the RCP suction safe end. The Loss of Secondary Pressure transient is not required to be considered for the fatigue crack growth because only the Level A/B and test transients are considered. However, for the flaw stability evaluation, the Loss of Secondary Pressure transient should be considered. For the flaw stability evaluation performed in [6, 20], it was determined that the Loss of Secondary Pressure transient was not the limiting transient used in the maximum allowable flaw size calculation; furthermore, it had a margin of approximately [ ]^{a,c} between the applied stress intensity factor and the allowable stress intensity factor (see Section 3.5 of [2]). The difference in the delta temperature and the ramp time of the temperature change for the cold leg, as compared to the hot leg transient, is not so severe that it would result in very large changes in the existing thermal stresses for the hot leg nozzle. Therefore, the severity of the RCP suction safe end Loss of Secondary Pressure transient is not sufficient to significantly reduce the margin of [ ]^{a,c} between the applied and allowable stress intensity factors. Therefore, the flaw stability calculation for the hot leg nozzle is sufficient and representative for the RCP suction safe end location.

4.2 Evaluation of Mechanical Loads

An additional consideration in the calculation of the stress field in the vicinity of the crack is the stress due to mechanical loads. The mechanical load stresses used in [6, 20] and discussed in [2] for the hot leg piping are evaluated in Appendix C of [11]. It is demonstrated by comparison, as illustrated in Table 4-1 and Table 4-2, that the mechanical load stresses evaluated for the hot leg piping conservatively bound the mechanical load stresses in the RCP suction safe end.

The pressure load applied to the hot leg and RCP suction safe end is identical. Therefore, the stress in each is based on the pipe geometry. From Appendix C of [11], the stress in the pipe, based on thick-wall theory, can be calculated as:

$$\sigma = P\left(\frac{R_i^2}{R_o^2 - R_i^2}\right)$$

In the previous equation:

P = operating pressure (2,250 psi)

R_i = inner radius of the pipe

R_o = outer radius of the pipe

The radii can be calculated by dividing the diameter values given in Table 4-2 by a factor of two. The resulting operating pressure stress values are [ ]^{a,c} ksi for the hot leg and [ ]^{a,c} ksi for the RCP suction safe end. The stress in the hot leg pipe due to operating pressure conservatively bounds the RCP suction safe end stress.

The piping mechanical loads used to evaluate the piping stress are the pipe axial load and the bending moment. The mechanical loads applied to the hot leg piping and RCP suction safe end are compared in Table 4-1. The comparison shows that the axial load on the hot leg piping is [ ]^{a,c} times greater than the axial load on the RCP suction safe end. The axial stress area ratios are compared in Table 4-2. This comparison shows that the axial stress area ratio of [ ]^{a,c} is much less than the axial load ratio of [ ]^{a,c}. A similar comparison can be made for the applied bending moments. Table 4-1 shows that the hot leg bending moment is [ ]^{a,c} times greater for normal operating conditions and [ ]^{a,c} times greater for operating basis earthquake (OBE). A comparison of the section modulus in Table 4-2 shows that the section modulus ratio of [ ]^{a,c} is less than the minimum bending moment ratio of [ ]^{a,c}. These comparisons show that the mechanical loads applied to the hot leg piping, and the resulting stress field evaluated in [2], provide bounding results when compared to the mechanical loads applied to the RCP suction safe end and the stress field that would result from these loads.

Table 4-1: Comparison of Hot Leg Piping and RCP Suction Safe End Loads

Load Type	Condition	Hot Leg Loads(2)	RCP Suction Safe End Loads(3)	Load Ratio (Hot Leg/ RCP Safe End Nozzle)
Axial (kips)	NO_4(1)	[ ]a,c	[ ]a,c	[ ]a,c
	OBE	[ ]a,c	[ ]a,c	[ ]a,c
Bending (ft-kips)	NO_4(1)	[ ]a,c	[ ]a,c(4)	[ ]a,c
	OBE	[ ]a,c	[ ]a,c	[ ]a,c

Notes:
(1) The NO_4 condition corresponds to the loads due to deadweight, normal operating thermal expansion, and friction.
(2) Loads are from [11].
(3) Loads are from [12], reported for Assembly P-4 at the "B" end of piping.
(4) Equal to the square root sum of the squares of M_x and M_z moments in [12].

Table 4-2: Comparison of Hot Leg and RCP Suction Safe End Geometric Properties

Dimension	Hot Leg(1)	RCP Suction Safe End(2)	Ratio (Hot Leg/ RCP Safe End Nozzle)
Inner Diameter (in)	[ ]a,c	[ ]a,c	---
Outer Diameter (in)	[ ]a,c	[ ]a,c	---
Area (in^2)(3)	[ ]a,c	[ ]a,c	[ ]a,c
Section Modulus (in^3)(4)	[ ]a,c	[ ]a,c	[ ]a,c

Notes:
(1) Dimensions are from [11].
(2) Dimensions are from [13]; the inner diameter is based on the minimum wall thickness of 76.2 mm (3.0 inches).
(3) Area is calculated as: π*diameter^2/4.
(4) Section modulus is calculated as: [π*(outer diameter^4 - inside diameter^4)/64]/(outer diameter/2).

5.0 Fracture Mechanics Evaluation

An overall transient stress comparison performed in Section 3.0 determined that the stress evaluation in [2] envelops the Palo Verde Unit 3 suction safe end instrumentation nozzle half-nozzle repair. Therefore, the hot leg transient stresses used in the allowable flaw size determination and fatigue crack growth evaluation [2], and used in the basis document [6, 20], would bound the Palo Verde Unit 3 RCP suction safe end transient stresses.

The stress field, geometry, and flaw size are the major contributors to the calculation of stress intensity factors. Based on the discussion in Section 3.0, the hot leg transient stresses used in the allowable flaw size determination and fatigue crack growth evaluation [2], and used in the basis document [6, 20], would bound the Palo Verde Unit 3 RCP suction safe end transient stresses.

The stress intensity factor model used in the hot leg nozzle flaw evaluation is based on a hole in a flat plate, with two cracks emanating from the corners. The bounding axial and circumferential flaw geometries are shown in Figure 5-1 and Figure 5-2; the stress intensity model is shown in Figure 5-3. The hole diameter used in the hot leg nozzle repair evaluation (diameter = [ ]a,c inches) from [6, 20] is similar in size to the suction safe end instrumentation nozzle hole diameter (diameter = [ ]a,c inches) in [13]. This slight difference would have an insignificant effect of the calculated stress intensity factors. Additionally, the difference in the thickness of the hot leg nozzle of 3.75 inches, as compared to the cold leg nozzle thickness of 3.0 inches, will have an insignificant impact on the fracture mechanics analysis and the stress intensity factor calculation. This is because, based on a review on the stress intensity factor database used in [6, 20], the influence coefficients used in the stress intensity factor calculation do not significantly change between flaw depth-to-wall thickness ratios of a/t = 0.2 to a/t = 0.5. The flaw depth to wall thickness ratio (a/t) of both the hot leg and cold leg is approximately 0.3. Furthermore, according to Section 3.5 of [2], there is ample margin between the calculated stress intensity factors and the allowables to account for any small changes in component geometries.

According to Section 3.5 of [2], the limiting transient (with respect to allowable circumferential flaw size) was the cooldown transient, particularly the end of the cooldown transient. The end of cooldown is generally limiting due to the low temperature that affects the fracture toughness of the component. The fracture mechanics evaluations in [2] and in its supporting document, [6, 20], were performed according to the 1992 Edition of the ASME Section XI Code, where IWB-3612 determined acceptability for normal and upset condition transients based on the following criterion:

$$K_I < K_{Ia}/\sqrt{10}$$

However, for Palo Verde Unit 3, the 2001 Edition with 2003 Addenda Section XI ASME Code is the Code of record. The acceptance criterion for normal and upset condition transients in IWB-3612 in the 2001 Edition with 2003 Addenda Section XI ASME Code is based on the following criterion:

$$K_I < K_{Ic}/\sqrt{10}$$

Since K_{Ic} is less limiting than K_{Ia}, the calculated axial and circumferential flaw stress intensity factors for the End of Cooldown transient in Section 3.5 of [2] (and Table 2-2 of [6, 20]) would have additional margin over the allowables based on the current Palo Verde Unit 3 ASME Section XI Code year. As documented in Section 3.5 of [2], and corrected in [20], an RT_{NDT} value of 60°F was utilized in the allowable stress intensity factor calculation for the hot leg base metal. The use of an RT_{NDT} value of 60°F in [2] was confirmed based on a review of the allowable stress intensity factor for the End of Cooldown transient. For the RCP suction safe end, the RT_{NDT} is 40°F or less according to the RCP suction safe end Certified Material Test Report and UFSAR Table 5.2-29B [10]. Therefore, the lower RT_{NDT} value of 40°F for the Palo Verde Unit 3 cold leg nozzle would result in a less limiting allowable flaw size than the hot leg nozzle RT_{NDT} of 60°F. As such, the allowable flaw size evaluation performed in [2] for a hot leg nozzle repair would be conservatively representative for the Palo Verde Unit 3 RCP suction safe end instrumentation nozzle since stress intensity factors for the same size flaws would be similar.

The fatigue crack growth evaluation performed in [2] demonstrated that crack growth for 40 years was small, and that the axial and circumferential flaws remained within the allowables. Table 5-1 and Table 5-2 show the crack growth for 40 years of operation to compare with the allowable flaw sizes from the generic hot leg piping evaluation (Section 3.4 of [2]) and the Palo Verde-specific hot leg piping evaluation from [5]. Since the stresses, stress intensity factors, and allowable flaw sizes used in [2] are considered bounding for the Palo Verde Unit 3 suction safe end instrumentation nozzle repair, the amount of fatigue crack growth tabulated in Table

5-1 and Table 5-2 for 40 years is expected to far exceed the anticipated fatigue crack growth for an 18-month duration in the Palo Verde Unit 3 suction safe end instrumentation nozzle.

Table 5-1: Hot Leg Piping Fatigue Crack Growth from [2] and [6, 20]

Depth or Length	Initial (in)	Axial Final (in)	Axial Allowable (in)	Circumferential Final (in)	Circumferential Allowable (in)
Depth	0.938	0.984	1.3	1.001	1.3
Length	0.762	0.791	1.1	0.802	1.1

Table 5-2: Hot Leg Piping Fatigue Crack Growth Using PVNGS Dimensions [5]

Depth or Length	Initial (in)	Axial Final (in)	Axial Allowable (in)	Circumferential Final (in)	Circumferential Allowable (in)
Depth	0.950	0.999	1.3	1.017	1.3
Length	0.762	0.793	1.1	0.805	1.1

Since the fracture mechanics evaluation in [2] concluded that the half-nozzle repair was acceptable with respect to Section XI of the ASME Code for 40 years of operation, and since the fracture mechanics evaluation in [2] has been found to be bounding for the Palo Verde Unit 3 suction safe end instrumentation nozzle half-nozzle repair, it is concluded that the flawed Palo Verde Unit 3 suction safe end instrumentation nozzle weld will remain acceptable with respect to fatigue crack growth though the suction safe end for an operating duration of 18 months.

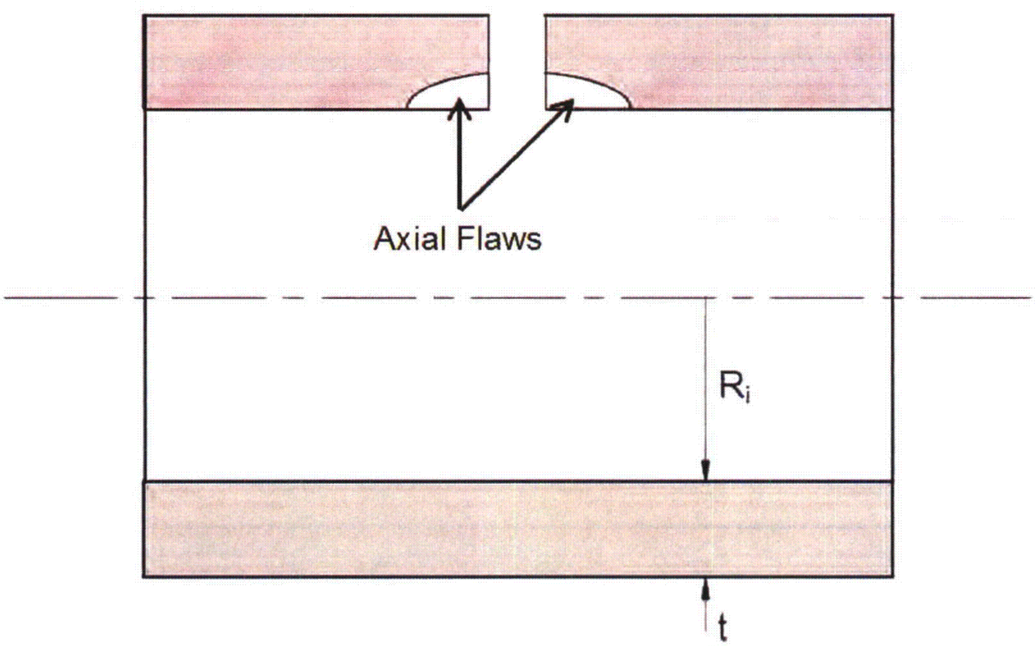


Figure 5-1: Axial Flaw Geometry

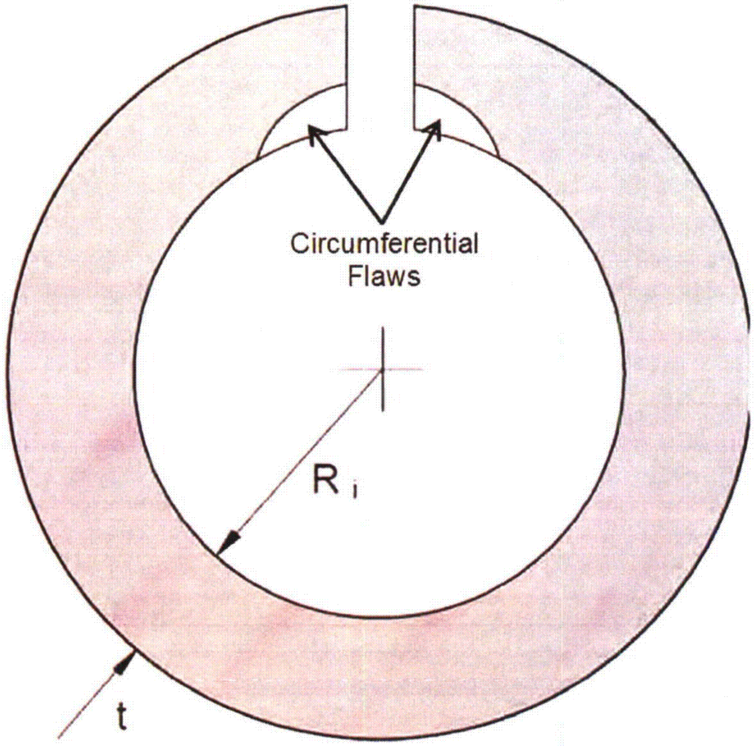


Figure 5-2: Circumferential Flaw Geometry

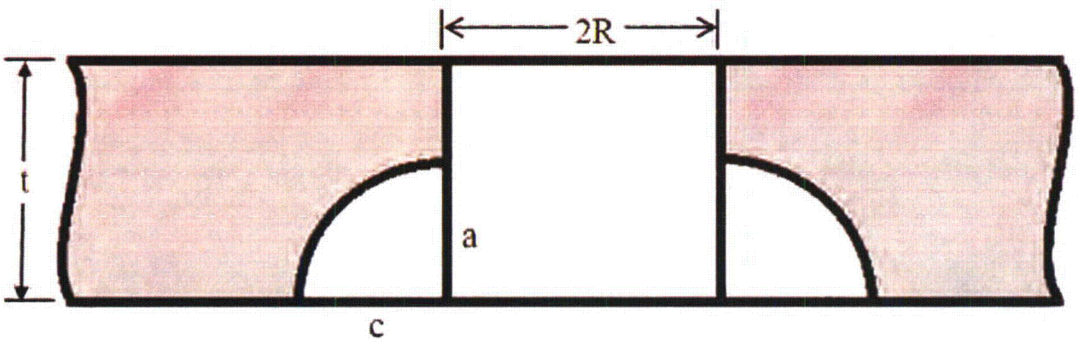


Figure 5-3: Stress Intensity Factor Model

6.0 Stress Corrosion Cracking Assessment

According to the NRC SE for WCAP-15973-P-A [3], the stress corrosion assessment in [2] may be used in the relief request as long as a review of plant chemistry is conducted to ensure that flaws in the carbon steel base metal material will not grow by stress corrosion. Stress corrosion and plant chemistry evaluations were previously conducted in [5]. The hot leg nozzle repair relief request determined, through a review of chemistry records and chemistry control procedures, that the plant chemistry was within the bounds of the standards of [2] and that the stress corrosion cracking conclusion reached in [2] also applies to the Palo Verde Unit 3 RCP suction safe end. Provided below is an excerpt from the Palo Verde relief request for the hot leg nozzle and the NRC SE [14], which is still applicable for the RCP suction safe end region.

> <u>*NRC Requirement 1*</u>
>
> *Conduct appropriate plant chemistry reviews and demonstrate that a sufficient level of hydrogen overpressure has been implemented for the RCS, and that the contaminant concentrations in the reactor coolant have been typically maintained at levels below 10 part per billion (ppb) for dissolved oxygen, 150 ppb for halide ions, and 150 ppb for sulfate ions.*
>
> <u>*APS Response*</u>
>
> *A review of plant chemistry records show that the halide /sulfate concentration levels have been maintained below 150 ppb for chloride, fluoride, and sulfate over the two operating cycles prior to the repair. Oxygen levels are maintained below 10 ppb during power operation and below 100 ppb during plant startups (RCS temperature >250°F). There is no oxygen limit when the RCS temperature is below 250°F.*
>
> *An RCS hydrogen overpressure of > 15 cc/kg is established prior to criticality (hard hold point) and is maintained in a range of 25 to 50 cc/kg in Modes 1 and 2. In Modes 1 and 2, RCS hydrogen is a Control Parameter with Action Level 1 outside the range of 25 - 50 cc/kg, an Action Level 2, less than 15 cc/kg, and an Action Level 3 less than 5 cc/kg. Chemistry administrative control procedures do not allow critical reactor operation with the RCS hydrogen concentration less than 15 cc/kg without immediate corrective action. The nominal operating band for RCS hydrogen is 25 to 50 cc/kg.*
>
> *Thus the conclusion reached in the Westinghouse TR with respect to stress corrosion cracking, applies to PVNGS.*

The plant chemistry is expected to be within the standards of [2] for the next fuel cycle; therefore, the conclusion reached in [2] would apply to Palo Verde Unit 3 for that period.

7.0 Half-nozzle Repair ASME Section III Qualification

The replacement half-nozzle and attachment weld have been qualified to all applicable criteria of Section III, subsection NB of the 1974 ASME Code in the evaluation in [15]. The Section III evaluation considered primary stress, secondary stress, and the fatigue usage factor in the replacement nozzle and weld compared to ASME Code allowable limits. The Section III evaluation also includes consideration of the required weld reinforcement area, the potential for reduced weld throat due to corrosion, and the design of the Class 2 socket weld connecting the replacement nozzle to the Class 2 piping.

This repair activity moves the Class 1 boundary to the outside diameter of the RCP suction safe end. Therefore, the attachment weld is treated as a Class 1 component and is evaluated to be qualified for ASME Code Section III, subsection NB. Details for each evaluation are summarized below.

Replacement Instrumentation Half-nozzle Qualification

The replacement nozzle has been qualified for the following applied loading:

- mechanical nozzle loads applied from Class 2 piping
- thermal and pressure transient stresses
- inertial loads due to seismic and pipe break events
- mechanical suction safe end loads applied from cold leg piping

The replacement nozzle is qualified by comparing the input loads and geometry to a detailed evaluation of an identical instrumentation nozzle for a different plant. The only significant difference in the geometry of the nozzles is the nozzle length. The replacement half-nozzle is shorter than the compared nozzle because space is left for the remnant of the existing nozzle at Palo Verde Unit 3. The nozzle in the comparison calculation is welded to the RCP suction safe end on the inside surface of the RCP rather than on the exterior. The difference in the weld location has been accounted for in the development of nozzle mechanical loads to ensure that the loading evaluated is conservative.

The instrumentation nozzle secondary stresses and fatigue usages due to pressure and temperature transient loading were evaluated by reconciling the input transients with those evaluated for the existing evaluation of another plant. The attachment weld for the Palo Verde Unit 3 nozzle is on the outside diameter of the RCP suction safe end, whereas the full analysis of the comparison plant nozzle which has the attachment weld on the inside surface of the safe end. The effects of thermal and pressure transients on the outside diameter of the safe end will be less significant than those in the full evaluation on the inside surface for this similar plant. All normal operating, heatup and cooldown, upset, and faulted condition transients have been addressed in the detailed comparison included in [15].

Additionally, the existing evaluation was performed for the full life of the plant, while the replacement half-nozzle need only be qualified for 18 months of plant operation. The nozzle has been qualified for fatigue with a maximum fatigue usage factor is [ ][a,c] [15].

Attachment Weld Qualification

The attachment weld primary stresses are qualified using a detailed closed-form solution considering all mechanical loads. The weld secondary stresses and fatigue usages are qualified using the same methodology that was used for the nozzle by comparing them to the existing evaluation of a similar nozzle.

The primary stress evaluation of the attachment weld considers the following loadings:

- mechanical nozzle loads applied from Class 2 piping
- inertial loads due to seismic and pipe break events

- pressure loading in the RCP suction safe end
- blow-off pressure load
- mechanical suction nozzle loads applied from cold leg piping

The mechanical nozzle loads were combined with the loads due to inertial effects and the nozzle blow-off load. Hoop, axial, and radial stresses in the RCP suction safe end due to internal pressure, as well as mechanical suction safe end loads, were applied directly to the weld. These stresses were combined and compared to applicable stress intensity and shear stress allowable stresses per Section III, subsection NB of the 1974 ASME Code. There is sufficient margin in the stress evaluation of primary stresses in the weld.

The secondary stresses and fatigue usage in the weld are qualified along with the replacement nozzle by comparison to an existing evaluation. Therefore, the maximum fatigue usage is the same, [ ]a,c [15].

Weld Design Considerations

The attachment weld and Class 2 boundary socket welds are designed in accordance with Section III, subsection NB of the 1974 ASME Code.

The attachment weld is designed per the requirements of Section NB-3351.4 as a Category D partial penetration nozzle attachment weld. The weld depth and fillet leg sizes meet or exceed the required sizing per Figure NB-4244(d)-1 section (c) for a partial penetration connection weld.

The socket weld at the end of the instrumentation nozzle is designed as a Class 2 socket weld per the requirements of Section NC-3661.2. The socket weld is designed using the 2:1 ratio specified in 13-PN-0204 per the request of APS. This design exceeds the requirements of ASME Section NC-3661.2. The socket weld stresses are bounded by the qualification of the attached Class 2 piping because the weld is designed according to the sizing rules in NC-3661.2.

Vibration Assessment

The attachment weld has been moved from the inside surface of the RCP suction safe end to the outside surface as part of this repair effort. This creates a concern for the effects of potential vibration in the instrumentation nozzle and attached piping. This concern has been addressed by calculating the natural frequency of the instrumentation nozzle and attached Class 2 piping to ensure that the natural frequency of the piping is outside the range of the mechanical vibration frequency of the RCP.

The calculated natural frequency of the instrumentation nozzle and Class 2 piping was also used to determine the inertial loads on the nozzle due to seismic and pipe break inputs. These inertial loads were added to the mechanical loads used to evaluate the instrumentation nozzle and attachment weld.

<u>ASME Code Reconciliation</u>

Reference [19] addresses various ASME Code reconciliations for the use of a later edition of the ASME Code for the replacement instrumentation nozzle to be supplied to APS. The applicable Code year for the Section XI program at APS is 2001 up to and including 2003 Addenda. The Section III evaluation was performed to meet the requirements of the 1974 Code year (with no addenda). The reconciliation letter [19] compares the 1998 Edition up to and including 2000 Addenda, which was used in the procurement of material, fabrication, and examination of the nozzle, to the Original Construction Code. Reference [19] also reconciles the 1995 Edition up to and including 1997 Addenda to the Original Construction Code for the analysis/qualification used in the comparison evaluation of a similar instrumentation nozzle.

8.0 Loose Parts Evaluation

An evaluation of the potential for loose parts to enter the RCS was performed and documented in Reference 18. The half nozzle repair process involves leaving a small remnant of the existing pressure instrument nozzle welded in its original position. APS asked Westinghouse to address the possibility that fragments of the existing partial penetration weld could come loose inside the RCS during the next cycle of operation (18 months is assumed). Westinghouse and APS postulated, based on non-destructive examinations (NDE) performed to describe the flaws, that the crack(s) on the nozzle and or weld are part through wall in the axial direction with no evidence of circumferential cracks. This is consistent with the orientation previously observed by APS for this type of degradation mechanism (PWSCC) in instrument nozzles in the hot leg.

The remnant Inconel Alloy 600 instrument nozzle (approximately 1.5 inches in length) is recessed inside the safe end bore. It remains constrained by a relatively tight radial clearance between the bore and the nozzle. This is further helped by the weld deposited in this annular gap during the welding process. Therefore, even if the majority of the partial penetration weld was to break, it is not credible to assume that the remnant nozzle could become a loose part and become ejected into the RCS flow during the next 18 month fuel cycle. Additional assurance is provided considering that the hypothetical cracks are likely longitudinal part through wall, and as such the nozzle is able to maintain its structural integrity. Also, even if the partial penetration weld had several longitudinal radial cracks, it would require at least two other crack planes oriented in the circumferential direction in order to release a piece of any significant size. Since circumferentially-oriented cracks were not identified by the ultrasonic testing (UT), the likelihood for a fragment of the weld to be released is very low.

The pressure instrument nozzle partial penetration weld is an Inconel alloy compatible with the Inconel Alloy 600 nozzle. Based on the above, a conservatively sized fragment of weld was assumed to weigh approximately 0.1 pounds and have dimensions no greater than the partial penetration weld thickness at its cross-section, and a length of one-quarter of the circumference around the instrument nozzle.

Westinghouse evaluated the structural and functional impacts of the loose weld fragment(s) on affected SSCs. Engineering judgments were applied and prior PVNGS loose parts evaluation results were taken into consideration. The evaluation considered that although the aforementioned fragment represents one possible form of the loose part, it is possible that smaller fragments of different sizes, shapes, and weights could be released, or created. Additional smaller fragments are possible, for example, if a weld fragment were to make contact with a high-velocity RCP impeller blade, or perhaps make high-speed contact with the reactor vessel core barrel.

The evaluation concluded that the postulated loose parts will have no adverse impact on the RCS and connected SSCs after one cycle of plant operation. The evaluation addressed potential impacts to various SSCs where the loose parts might travel. This included the RCPs, the main coolant piping, the reactor vessel and its internals, the fuel, the pressurizer, steam generators, as well as other systems attached to the RCS, including the spent fuel pool. It was determined that all impacted SSCs would continue to be capable of satisfying their design functions.

9.0 Summary and Conclusions

During the spring 2015 refueling outage at Palo Verde Unit 3, visual examinations of the RCP suction safe end revealed evidence of leakage in the annulus between the outer surface of the Inconel 600 instrument nozzle and the bore on the suction safe end. The most likely location of the flaw(s) is in the PWSCC-susceptible Alloy 82/182 weld and Inconel 600 instrument nozzle, along their fusion line inside the safe end bore. The Alloy 600 instrument nozzle is attached with a partial penetration weld to the inside diameter of the RCP suction safe end.

The half-nozzle repair method will be used to replace a portion of the Alloy 600 one-inch instrument nozzle with an Inconel 690 PWSCC-resistant material half-nozzle, attached to the Palo Verde Unit 3 RCP suction safe end outside diameter. The ASME Class 1 pressure boundary and associated nozzle attachment weld will be relocated to the outside surface of the suction safe end. The (assumed) flawed partial penetration weld and a portion of the existing nozzle will be abandoned in place.

Westinghouse has previously performed a technical justification and a fracture mechanics investigation into the feasibility of small diameter Alloy 600/690 half-nozzle repairs WCAP-15973-P-A [2] and report CN-CI-02-71 [20], which the NRC has acceptable for referencing in licensing applications for CE designed pressurized water reactors as long as information required by the SE in is submitted as a relief request. The flaw evaluation performed in this report follows their guidance and demonstrates that a flaw in the partial penetration weld will not grow to an unacceptable size in the suction safe end base metal, for up to 18 months of operation.

The evaluation performed in this report demonstrates the acceptability of the half-nozzle repair for the flawed RCP suction safe end instrument nozzle at Palo Verde Unit 3 based on a corrosion evaluation, on an ASME Section XI crack growth evaluation, and on a flaw stability analysis.

The corrosion rate around the instrumentation nozzle bore was determined based on the operating mode corrosion rates of [2] and the plant operating history. Based on the overall corrosion rate, the instrumentation nozzle bore diameter remains acceptable for the end of life at Palo Verde Unit 3.

A comparison was made between the ASME Section XI Code evaluation of hot leg nozzle repairs [2] and the Palo Verde Unit 3 RCP instrumentation nozzle repair, and it was determined that the evaluation in [2], which was for 40 years of operation, would bound the repair condition for the instrumentation nozzle and the suction safe end of Palo Verde Unit 3 for at least 18 months. Furthermore, it was demonstrated that the previous relief request and the subsequent NRC SEs [5 and 14], documenting approval for the Palo Verde Units 1, 2, and 3 small-bore hot leg nozzles, are bounding and applicable for the RCP suction safe end instrumentation nozzle half-nozzle repair. Therefore, the half-nozzle repair for the RCP suction safe end is acceptable per Section XI of the ASME Code for at least the next 18 months of operation.

The evaluations in the Section III qualification calculation note [15] show that the replacement instrumentation half-nozzle, attachment weld, and Class 2 socket weld meet the applicable criteria of the ASME Code, 1974 Edition with no Addenda. This qualifies the relocation of the RCS pressure boundary and the new attachment weld according to subsection NB of the ASME Code.

The loose parts evaluation [18] concluded that the postulated loose parts will have no adverse impact on the RCS and connected SSCs after one cycle of plant operation. The evaluation addressed potential impacts to various SSCs where the loose parts might travel. This included the RCPs, the main coolant piping, the reactor vessel and its internals, the fuel, the pressurizer, steam generators, as well as other systems attached to the RCS, including the spent fuel pool. It was determined that all impacted SSCs would continue to be capable of satisfying their design functions.

10.0 References

1. ASME Boiler and Pressure Vessel Code, Section XI, 2001 Edition with 2003 Addenda.
2. Westinghouse Report, WCAP-15973-P-A, Rev. 0, "Low-Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600/690 Nozzle Repair/Replacement Programs," February 2005. (Westinghouse Proprietary Class 2)
3. NRC Letter, "Final Safety Evaluation for Topical Report WCAP-15973-P, Revision 01, "Low-Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600/690 Nozzle Repair/Replacement Program" (TAC No. MB6805)," January 12, 2005.
4. Combustion Engineering Report, A-CEOG-9449-1242, Rev. 00, "Evaluation of the Corrosion Allowance for Reinforcement and Effective Weld to Support Small Alloy 600 Nozzle Repairs," June 13, 2000. (Westinghouse Proprietary Class 2)
5. APS Letter, "Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, 3, Docket No. STN 50-528/529/530, 10 CFR 50.55a(a)(3)(i) Alternative Repair Request for Reactor Coolant System Hot Leg Alloy 600 Small-Bore Nozzles (Relief Request 31, Revision 1)." August 16, 2005. (ML Accession No. ML052550368)
6. Westinghouse Calculation Note, CN-CI-02-71, Rev. 1, "Summary of Fatigue Crack Growth Evaluation Associated with Small Diameter Nozzles in CEOG Plants," March 31, 2004. (Westinghouse Proprietary Class 2)

7. Combustion Engineering Specification, 00000-PE-140, Rev. 04, "General Specification for Reactor Coolant Pipe and Fittings," May 25, 1977. (Westinghouse Proprietary Class 2)

8. Combustion Engineering Report, CENC-1642, Rev. 0, "Analytical Report for Arizona Unit No. 3 Piping," May 1984. (Westinghouse Proprietary Class 2)

9. Combustion Engineering Specification, SYS80-PE-480, Rev. 02, "Specification for Standard Plant for Reactor Coolant Pumps," May 2, 1978. (Westinghouse Proprietary Class 2)

10. Palo Verde Nuclear Generating Station Units 1, 2, and 3 Updated Final Safety Analysis Report, Rev. 17B, January 2015.

11. Westinghouse Calculation Note, A-GEN-PS-0003, Rev. 3, "Evaluation of Fatigue Crack Growth Associated with Small Diameter Nozzles in CEOG Plants," December 9, 2005. (Westinghouse Proprietary Class 2)

12. Westinghouse Design Specification, 14273-PE-140, Rev. 15, "Project Specification for Reactor Coolant Piping and Fittings for Arizona Nuclear Power Project," June 25, 2007. (Westinghouse Proprietary Class 2)

13. CE – KSB Pump Co. Inc. Drawing, E-8111-101-2002, Rev. 00, "Pump Casing – A."

14. NRC Letter, "Palo Verde Nuclear Generating Station, Units 1, 2, and 3 – Relief Request No. 31, Revision 1, Re: Proposed Alternative Repair for Reactor Coolant System Hot-Leg Alloy 600 Small-Bore Nozzles (TAC Nos. MC9159, MC9160, and MC9161). ML Accession No. ML062300333.

15. Westinghouse Calculation Note, CN-MRCDA-15-13, Rev. 0, "Qualification of Palo Verde Unit 3 Reactor Coolant Pump Replacement Instrumentation Nozzle," April 16, 2015. (Westinghouse Proprietary Class 2)

16. Westinghouse Owners Group Letter, "Westinghouse Owners Group Transmittal of NRC-Approved Topical Report WCAP-15973-P-A (Proprietary) and WCAP-15973-NP-A, Rev 0, (Non-Proprietary) "Low-Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600/690 Nozzle Repair/Replacement Programs," (TAC MB6805) (Task 1170)," March 16, 2005.

17. Westinghouse Calculation Note, CN-PAFM-15-20, Rev. 2, "Palo Verde Unit 3 RCS Cold Leg Alloy 600 Small Bore Nozzle Repair Transient Stress and Fracture Mechanics Evaluation for One Cycle Operation," April 17, 2015. (Westinghouse Proprietary Class 2)

18. Westinghouse Report, TR-FSE-15-2, Rev. 1, "Palo Verde Nuclear Generating Station Unit 3 Evaluation of Potential Loose Part - Reactor Coolant Pump Instrument Nozzle Weld Fragment," April 17, 2015. (Westinghouse Proprietary Class 2)

19. Westinghouse Letter, LTR-ME-15-30, Rev. 2, "ASME Code Section XI Reconciliation for Arizona Public Service (APS), Palo Verde Nuclear Generating Station (PVNGS) Unit 3 Replacement Instrument Nozzle," April 16, 2015. (Westinghouse Proprietary Class 2)

20. Westinghouse Calculation Note, CN-CI-02-71, Rev. 2, "Summary of Fatigue Crack Growth Evaluation Associated with Small Diameter Nozzles in CEOG Plants," December 9, 2005. (Westinghouse Proprietary Class 2)

Attachment 3

APS Response to NRC Request for Additional Information (RAI), dated April 14, 2015

In an email (Reference 1), the NRC staff requested additional information (RAI) as a result of a phone call held between Palo Verde and NRC staff members on April 9, 2015. The phone call discussed the emergent situation regarding the leakage discovered on the Unit 3 reactor coolant pump (RCP) 2A suction pressure instrument nozzle. Palo Verde staff provided presentation slides (Reference 2). The RAI was discussed further with NRC staff in a phone call on April 15, 2015.

Each RAI question is listed below with a response that provides either a full answer or direction to the applicable discussion in the relief request. Additional information is included at the end of this attachment in support of NRC questions 1.a and 3.a.

NRC Question #1

Provide drawings of the original pressure instrument nozzle penetration that identify the following:

a. The essential components and parts of the nozzle penetration.
b. The bore of the reactor coolant pump (RCP) casing where the instrument nozzle is attached.
c. The nozzle itself (with drilled hole).
d. The J-groove weld.

The drawings should identify the dimensions of all major components and parts of the original pressure instrument nozzles, such as the diameter of the bore, orifice, RCP base metal thickness, and cladding. If these drawings were submitted as part of a previous licensing action, please provide references.

APS Response:

The two drawings to address item "a" above are included at the end of this attachment. The drawings to address items "b" through "d" are proprietary and are provided in Reference 3.

NRC Question #2

Provide the following information on the half nozzle repair:

a. Describe the detailed steps of the half nozzle repair.
b. Provide drawings of the half nozzle repair with the dimensions of all major components and parts of the repaired pressure instrument nozzles, such as the diameter and the length of the bore and cladding. Identify the demarcation of ASME Code Classification for components (i.e., ASME Class 1 vs. Class 2) and the primary system pressure boundary on the drawings after the repair is completed.
c. Provide a detailed drawing which shows the intersection between the new nozzle and old nozzle (i.e., the location of the 0.06 inch gap).

APS Response:

The drawings are provided in Reference 3.

NRC Question #3

Provide the following information on the new weld:

a. Discuss how the partial penetration weld will be made at the exterior RCP wall where the new nozzle is attached, including the welding process/method and the pre- and post-welding examination (method and areas of examination). Provide information on any pre- or post-heat treatment and the relevant ASME Code Section and subarticle to which the welding will be complied.
b. Provide the welding design drawing.
c. Discuss the inservice inspection of the new attachment weld, including how often the weld will be examined and the inspection method that will be used.

APS Response:

a. The weld traveler is included at the end of this attachment.
b. The drawings are provided in Reference 3.
c. The J-groove attachment weld of the replacement nozzle to the RCP 2A suction safe end outer surface will continue to be incorporated into the Boric Acid Walkdown program, which checks primary coolant system, structures, and components (SSCs) for indications of leakage. Since the repaired outer nozzle half is composed of PWSCC resistant materials (Alloy 690/52M), the requirements for augmented inspection of Code Case N722-1 will no longer apply.

NRC Question #4

Provide the applicability of the relief request, either by the month and year or the designated number (e.g., No. 11) of the next refueling outage.

APS Response:

Relief Request 53 is applicable for the duration of the Unit 3 19th operating fuel cycle, ending in the refueling outage U3R19. The U3R19 refueling outage is currently scheduled for fall 2016.

NRC Question #5

Discuss the impact of the high speed flow of coolant inside the RCP impinging on the degraded J-groove weld of the instrument nozzle. Discuss whether such impact would cause fragments of the J-groove weld to fall into the flow stream. Address if the potential loose parts of the J-groove would cause damage to the RCP internals.

APS Response:

APS evaluated the potential for loose parts that may be generated from assumed J-groove weld flaws that resulted in the identified leakage. This is summarized in Attachment 2 to this Enclosure. Reference 3 provides the proprietary version of this evaluation.

NRC Question #6

Discuss the condition (i.e., any degradation or leakage) of previously repaired Alloy 600 small bore instrumentation lines attached to hot leg.

APS Response:

Previously repaired RCS hot leg small bore nozzles are inspected pursuant to the Boric Acid Corrosion Control Program each refueling outage and no leakage has been identified.

NRC Question #7

By letter dated August 16, 2005, the licensee submitted Relief Request 31, Revision 1 (ADAMS Accession No. ML052550368). Based on the review of Relief Request No. 31, it appears that the licensee may need to calculate the metal loss of the bore in the RCP casing due to potential crevice corrosion as a result of the 0.06 inch gap existing between (1) the new nozzle and remnant nozzle in the flaw evaluation, (2) crack growth of existing flaw in the weld by thermal fatigue, and (3) growth of existing flaw in the weld into the RCP casing. Confirm that all flaw evaluations and crack growth calculations consider the period of extended operation.

APS Response:

Previous corrosion evaluations completed for Relief Request 31, Revision 1, remain valid for the Unit 3 19th operating fuel cycle duration being requested in Relief Request 53. The details are outlined in the summary of the analyses described in Attachment 2 of this Enclosure. Reference 3 provides the proprietary version of this evaluation. Since the duration of this relief request does not extend beyond the 19th operating fuel cycle, the analyses do not consider the period of extended operation.

NRC Question #8

In Relief Request 31, the licensee committed to track the time at cold shutdown conditions for each unit against the assumptions made in the corrosion analysis so that the overall general/crevice corrosion rate does not exceed the rate presented in WCAP-15973-P, Revision 1, *Low-Alloy Steel Component Corrosion Analysis Supporting Small Diameter Alloy 600/690 Nozzle Repair/Replacement Programs* . The licensee made the commitment to ensure the allowable bore diameter is not exceeded over the life of the plant.

a. Discuss whether this commitment has been carried out since 2005. If yes, discuss how the cold shutdown conditions have been tracked and how the bore diameter is monitored to ensure that it does not exceed the allowable diameter.
b. Discuss how often the required action in the commitment is performed.
c. If the commitment has not been carried out, provide justification.

APS Response:

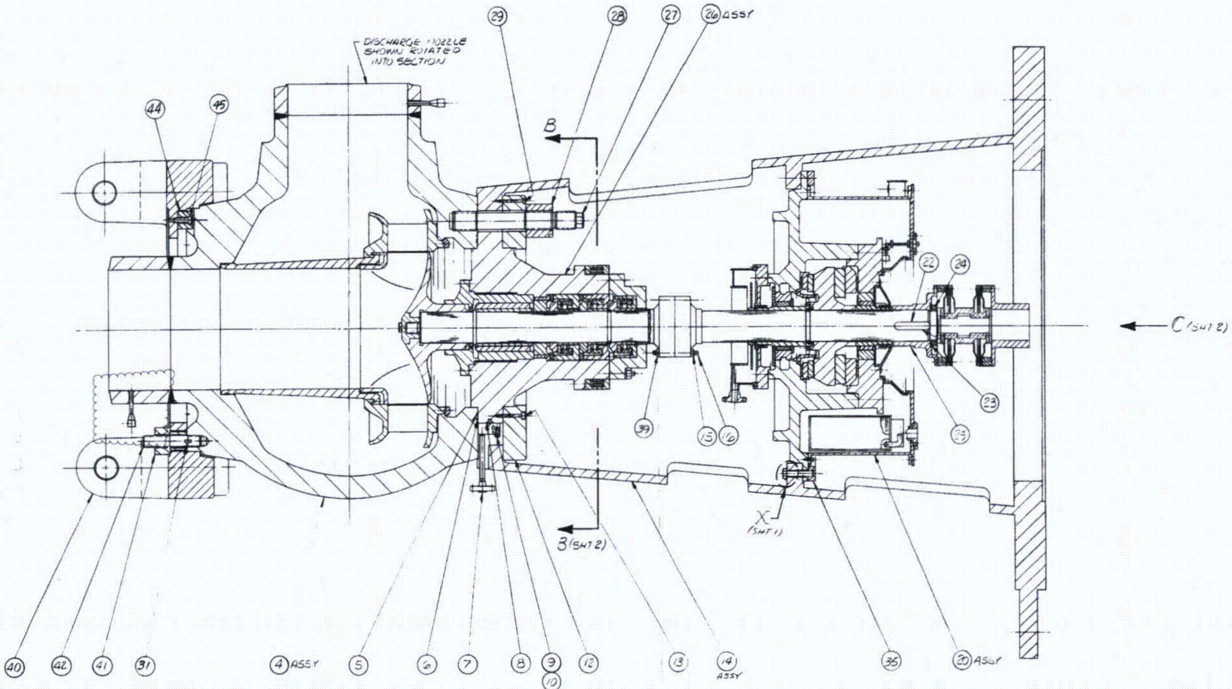
a. The commitment to monitor RCS conditions that affect assumptions in the corrosion analysis made for the RCS hot leg remains in effect. The analysis provided in Relief Request 31, Revision 1, assumed percentages of time to calculate total annual corrosion over a 60 year period. The percentage of time at both shutdown and start-up conditions is tracked by Engineering Study 13-MS-B041, *Alloy Steel Corrosion Analysis Supporting Alloy 600/690 Nozzle Repair/Replacement,* for half-nozzle repairs to other primary system components, including RCS hot leg instrument nozzles, pressurizer heaters, and the Unit 3 reactor vessel bottom mounted instrument nozzle number 3. This ongoing tracking will ensure that the corrosion evaluation remains bounding and therefore the allowable bore diameter is not exceeded.
b. The study 13-MS-B041 is updated with operating cycle information periodically and is current through the completion of most recent refueling outages (U1R18, U2R18, and U3R17) in each of the three Palo Verde units.
c. The monitoring program contained in the referenced engineering study remains in effect.

Additional Documents Included:

Two drawings that describe the original RCP 2A suction pressure instrument nozzle (Question 1.a) and weld traveler (Question 3.a) are included in this attachment.

References

1. NRC *Request for Additional Information Regarding Pressure Boundary Leakage Found on reactor Coolant Pump 2A Pressure Instrumentation Nozzle Palo Verde Nuclear Generating Station, Unit 3,* dated April 14, 2015, Agencywide Documents Access and Management System (ADAMS) Accession No. ML15104A810
2. Palo Verde Nuclear Generating Station, Units 3, April 9, 2015 - *Presentation on Potential Relief Request about Pressure Boundary Leakage on Reactor Coolant Pump 2A Pipe Nozzle*, ADAMS Accession No. ML15103A288
3. APS letter number 102-07037, *Palo Verde Nuclear Generating Station Unit 3, Docket No. STN 50-530, Transmittal of Proprietary Documents for Relief Request 53*, dated April 17, 2015



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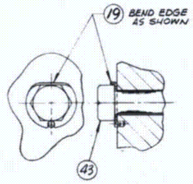

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NO SCALE
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Digitally signed by Zatcoff, Jessica E(VC6411)
DN: CN = Zatcoff, Jessica E (VC6411)
Reason: I CONVERTED THIS RECORD
Date: 2006.07.27 13:35:24 -07'00'

2. THE TWO ALIGNMENT PINS (B-8000-101-1007) ARE USED TO ALIGN THE PUMP CASING ASSY (ITEM 4), MOTOR SUPPORT ASSY (ITEM 14) & CLAMPING RING (ITEM 12) & ARE TO BE REMOVED PRIOR TO INSTALLATION OF THE 2 STUD NUTS (IT...

1. ALL DIMENSIONS ARE IN MM, METRIC ... U.S. EQUIVALENT IN PARENTHESIS FOR GUIDANCE ONLY.

THIS DWG AND ITS ASSOCIATED PARTS LIST WILL BE INCLUDED IN THE REACTOR COOLANT PUMP INSTRUCTION MANUAL. B.R.

E-8109-101-1000
SHEET 1 OF 2 | 00

MICROFILM QUALITY ACCEPTABLE

APPROVED

REVISED BY BECHTEL IN AGREEMENT WITH CE IN LETTER V-CE 4452 DATED 12-21-77

REV.	DESCRIPTION	BY & DATE	CHK. & DATE	ENG. APPD
▽				

UNLESS OTHERWISE SPECIFIED			
UNDER 6 ±0.1	6 TO 29 ±0.2	30 TO 119 ±0.3	120 TO 314 ±0.5
315 TO 999 ±0.8	1000 TO 1999 ±1.2	2000 TO 3999 ±2	OVER 4000 ±3
1 INCH = 25.400 MM (EXACT)		ANGLES ±1 1/2°	
FINISH AA-3.15 MICRO M		CHAMFER ±5°	
BREAK CORNERS 0.4 MAX. RAD. OR CHAMFER			
FILLETS 0.4 TO 0.8 RADIUS		THREADS I.S.O. METRIC	
DIMENSIONS IN MM BASED ON 20°C			

DRAWN BY: C. ROY — 5-26-77
CHECKED: — 5-27-77
APPROVALS: — 6/2/77
SCALE: NOTED — DO NOT SCALE DWG.

CE-KSB PUMP CO. INC.
NEWINGTON, N.H. 03801

CE-KSB PUMP TYPE 101

R.C.P. ASSEMBLY "A"

E-8109-101-1000 | 00
SHEET 1 OF 2

NEXT ASSY.
SUPERSEDES
COMPONENT CODE NO.

DISTRIBUTION IS FOR: REVIEW / INFO
MECHANICAL
BALANCE OF PLANT
BOILER/NSSS
PLANT UTILITIES
PLANT DESIGN
CONTROL SYSTEMS
ELECTRICAL
WIRING
CONDUIT
NDE
PAINTING & COATINGS
CIVIL/STRUCTURAL
NUCLEAR
STRESS
ARCHITECTURAL
STARTUP
CONSTRUCTION
NOT REQ'D BY ENGRG.
CLIENT
IDENTIFYING TITLE OF THIS DOCUMENT

DATA CODE 1.1
ACTIVITY PKG NO. 1417A
ENGR SYSTEM NO. RC
QUAL. CLASS Q
Bechtel Log No. 13-10-...
IMPORTANT
DATE RECEIVED
DOCUMENT STATUS

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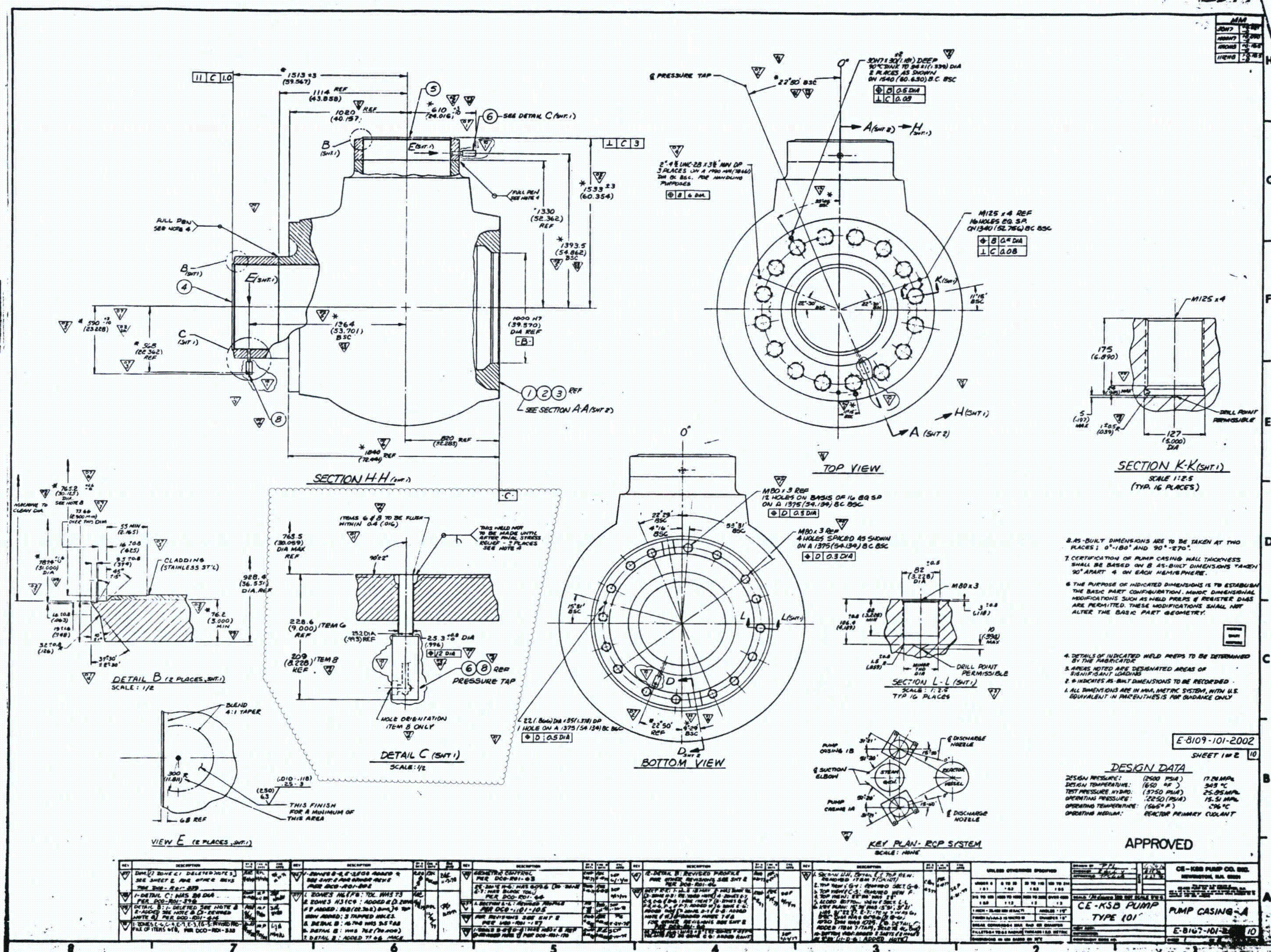


SECTION H-H (SHT 1)
TOP VIEW
SECTION K-K (SHT 1)
SCALE 1:2.5
(TYP. 16 PLACES)
BOTTOM VIEW
DETAIL B (2 PLACES, SHT 1)
SCALE: 1/2
DETAIL C (SHT 1)
SCALE: 1/2
VIEW E (2 PLACES, SHT 1)
SECTION L-L (SHT 1)
TYP 16 PLACES
KEY PLAN - RCP SYSTEM
SCALE: NONE
PRESSURE TAP
M125 x 4 REF
16 HOLES EQ. SP.
M80 x 3 REF
DRILL POINT PERMISSIBLE
CLADDING (STAINLESS ST'L)
THIS FINISH FOR A MINIMUM OF THIS AREA
HOLE ORIENTATION ITEM 8 ONLY
8. AS-BUILT DIMENSIONS ARE TO BE TAKEN AT TWO PLACES: 0°-180° AND 90°-270°.
7. CERTIFICATION OF PUMP CASING WALL THICKNESS SHALL BE BASED ON 8 AS-BUILT DIMENSIONS TAKEN 90° APART 4 ON EACH HEMISPHERE.
6. THE PURPOSE OF INDICATED DIMENSIONS IS TO ESTABLISH THE BASIC PART CONFIGURATION. MINOR DIMENSIONAL MODIFICATIONS SUCH AS WELD PREPS & REGISTER DIAS ARE PERMITTED. THESE MODIFICATIONS SHALL NOT ALTER THE BASIC PART GEOMETRY.
4. DETAILS OF INDICATED WELD PREPS TO BE DETERMINED BY THE FABRICATOR
3. AREAS NOTED ARE DESIGNATED AREAS OF SIGNIFICANT LOADING
2. * INDICATES AS-BUILT DIMENSIONS TO BE RECORDED.
1. ALL DIMENSIONS ARE IN MM, METRIC SYSTEM, WITH U.S. EQUIVALENT IN PARENTHESIS FOR GUIDANCE ONLY
E-8109-101-2002
SHEET 1 OF 2
10
DESIGN DATA
DESIGN PRESSURE: (2500 PSIA) 17.24 MPa
DESIGN TEMPERATURE: (650 °F) 343 °C
TEST PRESSURE, HYDRO: (3750 PSIA) 25.85 MPa
OPERATING PRESSURE: (2250 PSIA) 15.51 MPa
OPERATING TEMPERATURE: (565° F) 296 °C
OPERATING MEDIUM: REACTOR PRIMARY COOLANT
APPROVED
CE-KSB PUMP CO. INC.
CE-KSB PUMP TYPE 101
PUMP CASING-A

PCI EnergyServices
A subsidiary of Westinghouse Electric Company

PCI Quality Assurance Traveler

Date: 04/13/15

Project No. 908938	**Palo Verde**
Traveler No. 908938-01	**Reactor Coolant Pump (RCP) Pressure Wall Static Nozzle Repair**
Revision Number:	**1**
Project Location:	**Palo Verde Nuclear Generating Station Unit 3**
Client:	**Arizona Public Service (APS)**
Purchase Order No.	**500592773**

	Approvals	
PCI Author		
Chad A Ankeny	[signature]	4-13-15
PCI Project Manager	**Signature**	**Date**
Chris Vettese	[signature]	4-13-15
PCI Quality Assurance	**Signature**	**Date**
Mike Baughn	[signature]	4/13/15
Customer	**Signature**	**Date**
Authorized Nuclear Inservice Inspector	**Signature**	**Date**

Document No. 908938-01 Revision No.: 1

Title: Palo Verde: Reactor Coolant Pump (RCP) Pressure Wall Static Nozzle Repair

CHANGE NUMBER	PARAGRAPH NUMBER	CHANGE DESCRIPTION AND REASON
0		Original Issue
1	Page 2	Added Record of Changes Page.
	5.3	Added additional Code year and Addenda for Socket Welds.
	9.2.7	Added option to perform either Liquid Penetrant or Magnetic
		Particle Examination on the thermocouple removal areas.
	Page 15	Changed the J-weld prep to ½" + 1/16" – 0" with ¼" min
		reinforcing fillet.
	Page 16	Changed the J-weld prep to ½" + 1/16" – 0" with ¼" min
		Reinforcing fillet.
	Page 17	Changed Code year for fillet weld to 1974 Edition, Winter 1975
		Addenda.
	Page 15	Added step 11 for QC to measure from top of groove to the root
		pass weld deposit and record the dimension
	Page 16	Added steps 12, 13, 14 to weld, VT, and PT the additional 3/8" of
		Weld if the measurement in step 11 is greater than 3/8"

PCI Quality Assurance Traveler

Table of Contents

1.0 Purpose

This procedure / Quality Assurance Traveler provide the necessary steps for the removal and reinstallation of Reactor Coolant Pump (RCP 2A) Pressure Wall Static Nozzle.

2.0 Scope

This Quality Assurance Traveler is to provide the direction necessary for the welding, machining, Inspection and Examination required to perform the removal and reinstallation of Reactor Coolant Pump Pressure Wall Static Nozzle for Arizona Public Service, Palo Verde Nuclear Generating Station Unit 3.

3.0 Definitions

3.1 APS – Arizona Public Service, the utility that owns Palo Verde Nuclear Generating Station

3.2 W – Westinghouse Electric Company LLC

3.3 PCI – PCI Energy Services, LLC is a wholly owned subsidiary of Westinghouse Electric Company LLC. PCI provides personnel and equipment to perform welding and machining operations.

3.4 NDE – Non Destructive Examination

3.5 WPS – Welding Procedure Specification

3.6 ANII – Authorized Nuclear In-Service Inspector

4.0 References

4.1 PCI General Quality Procedures Manual, Rev. 54

4.2 PCI Quality Assurance Manual, Rev. 19

4.3 PCI PQP-908938-01, Latest Revision, "PCI Project Quality Plan"

4.4 PCI Welding Manual, 2nd Edition Rev 1

4.5 PCI General Welding Standard 1 GWS-1 ASME Applications

4.6 PCI Welding Manual, Welding Control Procedure WCP-5, "WELD AND BASE METAL REPAIR"

4.7 PCI Welding Manual, Welding Control Procedure WCP-6, "JOINT DESIGN"

4.8 PCI Welding Manual, Welding Control Procedure WCP-8, "PREHEATING AND POSTWELD HEAT TREATMENT"

4.9 PCI Welding Procedure Specification, WPS 143-F43 MN-GTA/SMA Rev 0 With Procedure Supplement dated 4/11/15.

4.10 PCI Welding Procedure Specification, WPS 8-43 F43 MN-GTAW Rev 0

4.11 PCI General Quality Procedure GQP-9.6 "VISUAL EXAMINATION OF WELDS"

5.0 Codes and Standards

5.1 ASME Section XI, 2001 Edition through 2003 Addenda

5.2 ASME Section III, Subsection NB, Class 1, 1974 Edition

5.3 ASME Section III, Subsection NB, Class 1, 1974 Edition, Winter 1975 Addenda for Socket Welds

5.4 ASME Section II, Parts C, "Material Specifications-Welding Rods, electrodes and Filler Metals", 2001 Edition and 2003 Addenda

6.0 Drawings

6.1 Westinghouse Drawing E-14473-220-001 Rev 0, Pressure Tap Nozzle Modification Assembly

6.2 Westinghouse Drawing C-14473-220-002 Rev 0, Replacement Pressure Tap Nozzle

6.3 Westinghouse Drawing 8114-101-2008 Rev 01, Nozzle – Pressure Wall Static

7.0 Material Type and Specification

7.1 Reactor Coolant Pump Casing – ASME SA – 508, Class 1

7.2 Replacement Nozzle – ASME SB – 166

7.3 Pipe – ASME SA 182 Gr. F316

PCI Quality Assurance Traveler

Customer: APS/Palo Verde	P.O. No. 500592773	Project No: 908938	Date: 04/12/15
Plant Modification/WO#:		"X" requires Production initials and date. Identify Hold or Witness Points by placing an "H" or "W" in the appropriate box below	

Seq. No.	Instructions	Comments/References	Initial and Date							
				Prod.		Cust.		QA/QC		ANII
8.0	**Prerequisites**									
8.1	Verify Welder Qualifications and all machinist Qualifications		X				H			
8.2	PCI workers have completed project specific training and the training is documented on training forms and filed in project book	PCI GQP 1.1 PCI Personnel Training and Indoctrination Record	X				H			
8.3	Pre-job briefing has been completed.		X							
8.4	FME Plan is approved and in place	FME Plan No.: ___________	X							
8.5	RWP is active and ready for use	RWP No.: ___________	X							
8.6	Ensure tooling is staged and ready for use		X							
8.7	Ensure services such as air and electric are available for use		X							
8.8	Verify Clearance Order is in place and walkdown is complete	CO No.: ___________	X							
8.9	Verify shielding wall is placed in accordance with the ALARA Plan		X							

PCI Quality Assurance Traveler

Customer: APS/Palo Verde	P.O. No. 500592773		Project No: 908938				Date: 04/12/15		
Plant Modification/WO#:			"X" requires Production initials and date. Identify Hold or Witness Points by placing an "H" or "W" in the appropriate box below						
Seq. No.	**Instructions**	**Comments/References**	**Initial and Date**						
				Prod.		Cust.		QA/QC		ANII
8.10	Weld Engineering to perform Indoctrination and training for preheat activities	WCP – 8 Rev 0 (ref. page 16 of this traveler)	**X**				**H**			
9.0	**Procedure**									
	NOTE: **Customer has removed the existing pipe that is connected to the RCP Tap. The customer has also removed the nozzle extension from the RCP and recorded the As-Found dimension from the 30" RCS line to the centerline of the ¾" pipe in Work Order 4641707 Task 0.**									
9.1	**RCP Tap Removal**									
9.1.1	Verify the site has removed the existing pipe and the nozzle extension from the suction to the swagelock fitting.		**X**							
9.1.2	Verify the plant has cut the existing nozzle before starting the drilling operation.		**X**							
9.1.3	Record the As-Found dimension from the 30" RCS Line to the ¾" Centerline Pipe measurement that has been recorded in Work Order 4641707 Task 0.	Measurement ________________	**X**				**H**			

PCI Quality Assurance Traveler

Customer: APS/Palo Verde	P.O. No. 500592773		Project No: 908938				Date: 04/12/15			
Plant Modification/WO#:			"X" requires Production initials and date. Identify Hold or Witness Points by placing an "H" or "W" in the appropriate box below							
Seq. No.	**Instructions**	**Comments/References**	**Initial and Date**							
				Prod.		Cust.		QA/QC		ANII
9.1.4	Install FME plug into the existing nozzle. Make sure the FME plug is inserted far enough into the nozzle that the machining operations will not affect the FME plug but FME integrity remains intact. Supervisor perform a peer check of plug depth.	Depth of FME Plug ____________	X							
9.1.5	Install saddle with chains and center drill to the existing nozzle bore		X							
9.1.6	Verify the 5/8" drill bit and also verify the hard stop on the drill bit is 1.68"+/-0.020"	Westinghouse Drawing E-14473-220-001 Rev 0	X				H			
9.1.7	Drill the 5/8" hole to a depth of 1.68" +/- 0.020"	Westinghouse Drawing E-14473-220-001 Rev 0	X							
9.1.8	Verify the 3/4" drill bit and also verify the hard stop on the drill bit is 1.68" +/-0.020"	Westinghouse Drawing E-14473-220-001 Rev 0	X				H			
9.1.9	Drill the 3/4" hole to a Depth of 1.68" +/- 0.020"	Westinghouse Drawing E-14473-220-001 Rev 0	X							
9.1.10	Verify the 7/8" drill bit and also verify the hard stop on the drill bit is 1.68" +/-0.020"	Westinghouse Drawing E-14473-220-001 Rev 0	X				H			
9.1.11	Drill the 7/8" hole to a Depth of 1.68" +/- 0.020"	Westinghouse Drawing E-14473-220-001 Rev 0	X							

PCI Quality Assurance Traveler

Customer: APS/Palo Verde	P.O. No. 500592773	Project No: 908938	Date: 04/12/15
Plant Modification/WO#:		"X" requires Production initials and date. Identify Hold or Witness Points by placing an "H" or "W" in the appropriate box below	

Seq. No.	Instructions	Comments/References	Initial and Date							
				Prod.		Cust.		QA/QC		ANII
9.1.12	Verify the 1" drill bit and also verify the hard stop on the drill bit is 1.68"+/-0.020"	Westinghouse Drawing E-14473-220-001 Rev 0	X				H			
9.1.13	Drill the 1" hole to a Depth of 1.68" +/- 0.020"	Westinghouse Drawing E-14473-220-001 Rev 0	X							
9.1.14	Take dimensional measurements of the bore diameter (horizontal and vertical) at 3 locations along the bore. (total of 9 measurements) and record on an inspection report.	GQP 10.0 Rev 18 Attachment C Inspection Report # ________________	X				H			
9.1.15	Present a copy of the inspection report to Westinghouse Engineering to determine what diameter the bore will need to be reamed. Record diameter the bore is to be reamed in step 9.1.16	**Westinghouse Engineering 24 HR Support:** **Eric Welsel 860-731-6558 Cell 860-874-1660** **Attila Szabo 860-731-6360 Cell 860-833-7781**	X							
9.1.16	Verify the boring bit is set to the dimension recorded in the comments column and also verify the hard stop is set 1.68" +/- 0.020"	Record diameter the bore is to be reamed. ________________	X				H			
9.1.17	Ream the nozzle bore using caution not to exceed 1.68" +/- 0.020"		X							

PCI Quality Assurance Traveler

Customer: APS/Palo Verde	P.O. No. 500592773	Project No: 908938	Date: 04/12/15
Plant Modification/WO#:		"X" requires Production initials and date. Identify Hold or Witness Points by placing an "H" or "W" in the appropriate box below	

Seq. No.	Instructions	Comments/References	Initial and Date							
				Prod.		Cust.		QA/QC		ANII
9.1.18	QC perform dimensional inspection of the nozzle bore depth at 0°, 180°, and diameter (horizontal and vertical) at 3 locations along the bore. (total of 9 measurements) and record on an inspection report.	GQP 10.0 Rev 18 Attachment C Inspection Report # ______	X				H			
9.1.19	Using the dimensional measurements taken in step 9.1.18 and the dimension recorded in step 9.1.3 the Project Manager is to determine the final length and diameter of the replacement nozzle and record both final dimensions. Ensure the nozzle is the proper length to align piping with the existing pipe support 3RC075H00A	Final Length ______ Final Diameter ______	X							
9.1.20	Perform the final machining of the replacement nozzle using the dimensions recorded in step 9.1.19		X							
9.1.21	QC perform final dimensional inspection of the replacement nozzle. Record final dimensions. Final dimensions should match dimensions recorded in step 9.1.19	Final Length ______ Final Diameter ______	X				H			

PCI Quality Assurance Traveler

Customer: APS/Palo Verde	P.O. No. 500592773		Project No: 908938				Date: 04/12/15			
Plant Modification/WO#:			"X" requires Production initials and date. Identify Hold or Witness Points by placing an "H" or "W" in the appropriate box below							
Seq. No.	**Instructions**	**Comments/References**	**Initial and Date**							
				Prod.		Cust.		QA/QC		ANII
9.1.22	APS to perform Liquid Penetrant Examination of all machined surfaces of the replacement nozzle	Report#________________	**X**				**H**			
9.1.23	Perform Weld prep. This step may be performed in parallel with steps 9.1.20 - 9.1.22	Westinghouse Drawing E-14473-220-001 Rev 0	**X**							
9.1.24	QC perform final dimensional inspection of the weld prep area.	Westinghouse Drawing E-14473-220-001 Rev 0	**X**				**H**			
9.1.25	APS to perform Liquid Penetrant Examination of weld prep area on the casing of the Reactor Coolant Pump	Westinghouse Drawing E-14473-220-001 Rev 0 Report#________________	**X**				**H**			
9.2	**Install New One Piece Nozzle**									
9.2.1	Verify FME Plug removal prior to nozzle installation		**X**		**H**		**H**			

PCI Quality Assurance Traveler

Customer: APS/Palo Verde	P.O. No. 500592773		Project No: 908938				Date: 04/12/15			
Plant Modification/WO#:			"X" requires Production initials and date. Identify Hold or Witness Points by placing an "H" or "W" in the appropriate box below							
Seq. No.	**Instructions**	**Comments/References**	**Initial and Date**							
				Prod.		Cust.		QA/QC		ANII
9.2.2	Layout the RCP Casing thermocouple locations as dictated by PCI Weld Engineering	WCP 8 Rev 0 PCI preheat document (page 18)	X				H			
9.2.3	Install thermocouples	Team Industrial Procedure: Standard Practice SP-01 Rev 0	X				H			
9.2.4	Weld Nozzle to Pump Casing	PCI Weld Process Traveler for FW # W-01 (page 15)	X				H			
9.2.5	Mark areas where thermocouples are attached to the Reactor Coolant Pump		X				H			
	<u>NOTE:</u> **Use caution when removing the thermocouples. Do not remove any of the location markings of the thermocouple locations and do not remove any more base metal than necessary**									
9.2.6	Remove thermocouples		X							
9.2.7	APS to perform Liquid Penetrant or Magnetic Particle Examination of the thermocouple removal areas	Report#_______________	X				H			

PCI Quality Assurance Traveler

Customer: APS/Palo Verde	P.O. No. 500592773	Project No: 908938	Date: 04/12/15
Plant Modification/WO#:		"X" requires Production initials and date. Identify Hold or Witness Points by placing an "H" or "W" in the appropriate box below	

Seq. No.	Instructions	Comments/References	Initial and Date							
				Prod.		Cust.		QA/QC		ANII
9.3	**Install Pipe to Nozzle Weld**									
9.3.1	Weld Nozzle to Pipe	PCI Weld Process Traveler for FW # W-02 (page 17)	**X**				**H**			
10.0	**Closeout**									
10.1	Perform review of documentation for completeness and correctness		**X**		**H**		**H**			
10.2	Transmit final document package to the customer using a PCI Document Transmittal Form		**X**				**H**			

Field Weld No.: W-01

SYSTEM OR COMPONENT Palo Verde Unit 3 Reactor Coolant Pump Nozzle DRAWING NO. E-14473-220-001 Rev 0 LINE NO. N/A MARK NO. See Below MARK NO. See Below
Base Material SA 508 Class 1 to SB 166 Gr 690 Nom. Pipe Size N/A Nom. Wall Thks 3" Fillet Size: See Special Instructions Contract No. 500592773 PCI Project No. 908938
Code Edition/Addenda/Class ASME Sect III NB 1974 Edition Welding Procedure No. 143-F43 MN-GTA/SMA,R0 W/Supplement Special Instructions Weld is to be a J-weld prep 1/2" +1/16" – 0" with a ¼" min reinforcing fillet

Filler Material Requirements
Electrode Type ERNiCrFe-7A Bare/Covered-Size 3/32" Heat/Lot No. ______ Electrode Type ______ Bare/Covered-Size ______ Heat/Lot No. ______
Consumable Insert Type/Size N/A Heat No. N/A Backing Ring N/A Heat No. N/A
Purge Required: I.D. Purge N/A CFH : N/A Torch Purge Yes; Welding Grade Argon CFH 5 - 70

Heat Treat Requirements
Preheat Temp. 200 F° Min. Interpass Temp. Req. 350 F° Max. Post Weld Heat Req. N/A Procedure WCP - 8 Rev 0 for preheat only

INSTRUCTIONS	Req.	Prod.	QC	Cust.		ANII		Record/Remarks
1. Verify and record weld procedure, welder quals, and filler material.	X		H					
2. All prerequisites of this procedure have been completed	X		H					
3. Verify details for bevel and cleanliness	X		H					Drawing – E-14473-220-001 Rev 0
4. Verify and record heat/ mark no.'s of replacement nozzle.	X		H					MK# ______ MK# Existing RCP
5. Verify minimum preheat temp of 200 degrees.	X		H					Preheat temp: ______ M&TE: ______ Due Date: ______
6. **Critical Step:** Perform fit-up and tack welds per the following instructions: **To obtain fit-up, insert nozzle into bore until it stops at the bottom of the bore, measure and record the dimension from the RCP to the nozzle shoulder with the nozzle bottomed out in the bore, withdraw tube 1/16 inch minimum to obtain bottom clearance, and tack weld.**	X							Record Dimension ______
7. Verify fit up and tack welds Measure from the RCP to the nozzle shoulder and record that dimension. Dimension shall be 1/16" larger than the dimension recorded in step 6	X		H					Record Dimension ______

Instructions	Req.	Prod.	QC	Cust.		ANII		Record/Remarks
8. Perform the root pass of the weld and stop. **Monitor and record interpass temp.**	X							Interpass Temp = ______ M&TE: ______ Due Date: ______
9. VT Perform Visual Inspection of Root Pass.	X		H					GQP 9.6 Rev.14
10. PT of the Root pass of weld performed by others	X		H					Report# ______
11. QC measure from the top of the j-groove (RCP Casing) to the top of the root pass weld deposit and record the dimension. If the dimension is over 3/8" proceed to step 12. If the dimension is 3/8" or less proceed to step 15 and NA steps 12 thru 14								Record Dimension ______

APPROVED	APPROVED	APPROVED	APPROVED
ANII ______ DATE ______	CUSTOMER ______ DATE ______	[signature] 4-13-15 PCI PROJECT MANAGER DATE	[signature] 4/13/15 PCI QA DATE

Field Weld No.: W-01 __

SYSTEM OR COMPONENT Palo Verde Unit 3 Reactor Coolant Pump Nozzle DRAWING NO. E-14473-220-001 Rev 0 LINE NO. N/A MARK NO. See Page 15 MARK NO. See Page 15
Base Material SA 508 Class 1 to SB 166 Nom. Pipe Size N/A Nom. Wall Thks 3" Fillet Size: See Special Instructions Contract No. 500592773 PCI Project No. 908938
Code Edition/Addenda/Class ASME Sect III NB 1974 Edition Welding Procedure No. 143-F43 MN-GTA/SMA, R0 W/ Supplement Special Instructions Weld is to be a J-weld prep 1/2" +1/16" – 0" with a ¼" min reinforcing fillet

INSTRUCTIONS	Req.	Prod.	QC	Cust.	ANII	Record/Remarks
12. Perform the next 3/8" of the J-weld and stop. **Monitor and record interpass temp.** N/A Step if not needed		X				Interpass Temp = ______ M&TE: ______ Due Date: ______
13. VT Perform Visual Inspection of J weld after additional 3/8". N/A Step if not needed		X	H			GQP 9.6 Rev.14
14. PT of the additional 3/8" of J weld performed by others. N/A Step if not needed		X	H			Report#______
15. Perform the remainder of the J-weld and stop. DO NOT PERFORM THE FILLET WELD AT THIS TIME **Monitor and record Interpass temp.**		X				Interpass Temp = ______ M&TE: ______ Due Date: ______
16. VT Perform Visual Inspection of completed J weld.		X	H			GQP 9.6 Rev.14
17. PT of the completed J weld performed by others		X	H			Report#______
18. Perform the Reinforcing fillet weld **Monitor and record interpass temp.**		X				Interpass Temp = ______ M&TE: ______ Due Date: ______
19. VT Perform Visual Inspection of completed Reinforcing fillet weld.		X	H			GQP 9.6 Rev.14

Instructions	Req.	Prod.	QC	Cust.	ANII	Record/Remarks
20. PT of the completed Reinforcing fillet performed by others		X	H			Report#______
21. Ensure the welder ID numbers for each weld layer are documented.		X	H			
22. Final Documentation Review		H	H	H		

Welder ID/ Tack Welds:

Welder ID/ Root and Hot Pass:

Welder ID/ Intermediate Layers:

Welder ID/ Final Layer:

Field Weld No.: W-02

SYSTEM OR COMPONENT: Palo Verde Unit 3 Reactor Coolant Pump Nozzle
ISO/ DRAWING NO.: E-14473-220-001 Rev 0
LINE NO.: N/A
Mark NO.: See Below
MARK NO.: See Below

Base Material: SA 182 Gr F316 to SB 166 Gr 690 Nom. Pipe Size: 3/4" Schedule 160 Nom. Wall Thks: .219 Fillet Size: 1/4" Fitting Side X 1/2" on pipe side Contract No. 500592773 **PCI Project No. 908938**

Code Edition/Addenda/Class: ASME Section III, Subsection NB, Class 1, 1974 Edition, Winter 1975

Welding Procedure No.: 8-43-F43 MN-GTAW, R0 Special Instructions: 2 – 1 taper fillet weld

Filler Material Requirements
Electrode Type: ERNiCrFe-7A Bare/ Covered Size: 3/32" Heat/Lot No.: ____ Electrode Type: ____ Bare/Covered-Size: ____ Heat/Lot No.: ____

Consumable Insert Type/Size: N/A Heat No.: N/A Backing Ring: N/A Heat No.: N/A

Purge Required: I.D. Purge: NO CFH: N/A Torch Purge: Yes; Welding Grade Argon CFH: 5 - 60

Heat Treat Requirements
Preheat Temp. 50 F° Min. Interpass Temp. Req 350F° Max. Post Weld Heat Req. N/A Procedure: ____

INSTRUCTIONS	Req. Prod.		QC		Cust.		ANII	Record/Remarks	Instructions	Req. Prod.		QC		Cust.		ANII	Record/Remarks
1. Verify and record weld procedure, welder quals, and filler material.	X		H						7. Verify fit up and tack welds Document Welder ID Below	X		H					
2. All prerequisites of this procedure have been completed	X		H						8. Perform the remainder of the weld Document Welder ID Below **Monitor and record interpass temp.**	X							Interpass Temp = ____ M&TE: ____ Due Date: ____
3. Verify details for bevel and cleanliness	X		H					Drawing – E-14473-220-001 Rev 0	9. Perform VT of final as welded surface. Ensure the welder ID numbers for each weld layer are documented	X		H					GQP 9.6 Rev 14
4. Verify and record heat/ mark no.'s of replacement nozzle	X		H					MK# ____ MK# Existing Pipe____	10. PT of the completed socket weld performed by others	X		H					Report# ____
5. Verify minimum preheat temp.	X		H					Preheat temp: ____ M&TE: ____ Due Date: ____	11. Final Documentation Review	H		H		H			
6. **Critical Step:** Perform fit-up and tack welds per the following instructions: **To obtain fit-up, mate sections up tight, scribe tube 1/2 inch from socket shoulder, and withdraw tube approximately 1/16 inch to obtain bottom clearance, and tack weld.**	X							WCP – 6 Rev	Tacks: Welder ID: ____ Welder ID: ____	Root Pass: Welder ID: ____ Welder ID: ____							Intermediate and Final: Welder ID: ____ Welder ID: ____

APPROVED	APPROVED	APPROVED	APPROVED
ANII ____ DATE ____	CUSTOMER ____ DATE ____	PCI PROJECT MANAGER [signature] DATE 4-13-15	PCI QA [signature] DATE 4/13/15

PCI Energy Services Traveler 908938-01 Rev.1
Palo Verde Unit 3 Project: 908938

WELD SPECIFIC PWHT REQUIREMENTS
FOR
FIELD WELD No. W-01

WELD PROCESS TRAVELER No. 908938-01 (W01)

WPS No. 143-F43 MN GTA/SMA Rev, 0

Base Metal P-No. 1 Gr. 2 Welded to P-No. 43 Gr. N/A

Nominal Pipe Size (inches): ¾" Nominal Thickness / Weld Size (inches): 0.219"

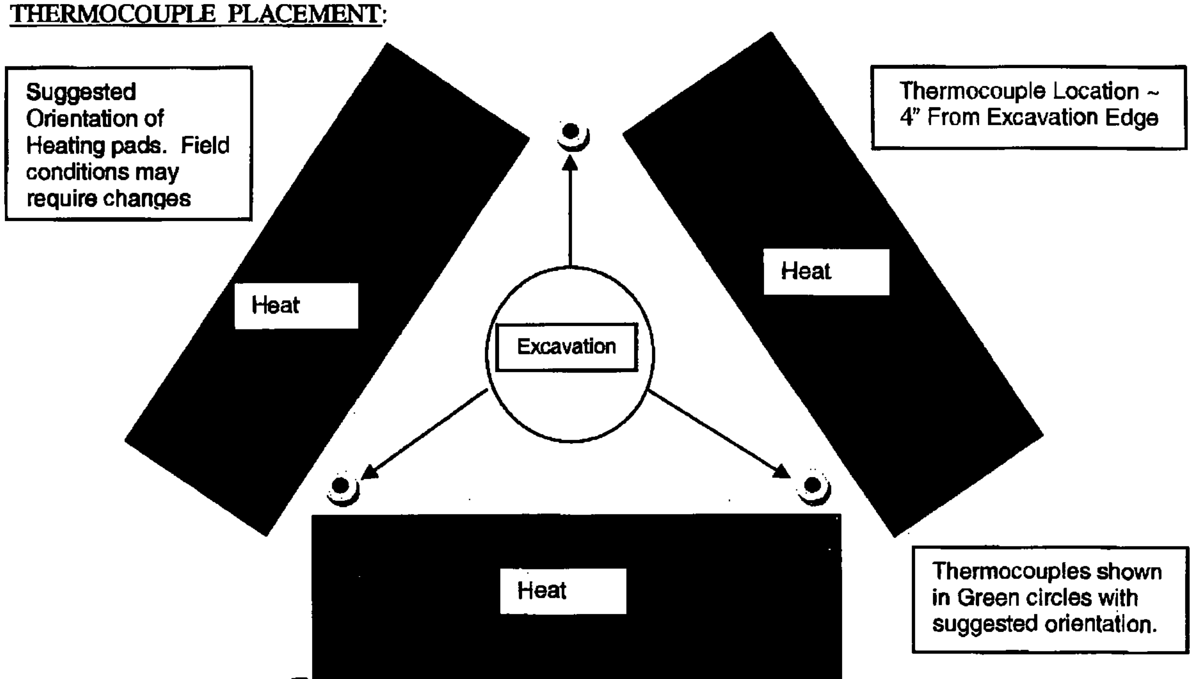
Connection # N/A Location: Palo Verde Unit 3

Code Class: 1 Maximum Heating/Cooling Rates: N/A °F/hr

Pre-Heat Temperature: 200 °F. Holding Time: N/A

SPECIAL INSTRUCTIONS: Record actual thermocouple locations on the place map at time of placement. Placement shall be in accordance with WCP-8.

THERMOCOUPLE PLACEMENT:



Prepared By: ______________________ Date: 4/12/2015
(Welding Engineer)