May 5, 2005

Mr. Gregg R. Overbeck
Senior Vice President, Nuclear
Arizona Public Service Company
P. O. Box 52034
Phoenix, AZ 85072-2034

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNIT 2 RELIEF REQUEST NO. 31 RE: PROPOSED ALTERNATIVE REPAIR FOR REACTOR COOLANT SYSTEM HOT LEG ALLOY 600 SMALL-BORE NOZZLES (TAC NO. MC6500)

Dear Mr. Overbeck:

By letter dated March 25, 2005, as supplemented by letter dated April 14, 2005, Arizona Public Service Company submitted Relief Request No. 31, requesting relief from certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) requirements at Palo Verde Nuclear Generating Station (Palo Verde), Unit 2. The request for relief would allow an alternative repair for 10 Alloy 600 small-bore reactor coolant system hot leg nozzles in lieu of the ASME Code Section XI requirements for required flaw examinations and successive inspections.

Based on the enclosed Safety Evaluation, the NRC staff concludes that the proposed alternative provides an acceptable level of quality and safety. The NRC staff concludes that granting relief pursuant to 50.55a(g)(6)(i) of Title 10 of the *Code of Federal Regulations* is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Therefore, the NRC staff authorizes the proposed alternative at Palo Verde, Unit 2, for the second, third, and fourth 10-year inservice inspection intervals with the regulatory commitments made by the licensee as listed in the enclosed Safety Evaluation. All other requirements of the ASME Code, Section III and XI for which relief has not been specifically requested and approved remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Sincerely,

/RA/

Robert A. Gramm, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. STN 50-529

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE INSPECTION PROGRAM RELIEF REQUEST NO. 31

ARIZONA PUBLIC SERVICE COMPANY, ET AL.

PALO VERDE NUCLEAR GENERATING STATION, UNIT 2

DOCKET NO. STN 50-529

1.0 INTRODUCTION

By letter dated March 25, 2005 (Agencywide Documents Access and Mangement System (ADAMS) Accession No. ML050950358), as supplemented by letter dated April 14, 2005 (ADAMS Accession No. ML051160183), Arizona Public Service Company submitted Relief Request No. 31, requesting relief from certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) requirements at Palo Verde Nuclear Generating Station (Palo Verde or PVNGS), Unit 2. The request for relief would allow an alternative repair for 10 Alloy 600 small-bore reactor coolant system hot leg nozzles in lieu of the ASME Code Section XI requirements for required flaw examinations and successive inspections.

2.0 REGULATORY REQUIREMENTS

The inservice inspection (ISI) of the ASME Code Class 1, 2, and 3 components in nuclear plants is to be performed in accordance with the ASME Code Section XI and applicable edition and addenda as required by 50.55a(g) of Title 10 of the *Code of Federal Regulations* (10 CFR), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). The regulation at 10 CFR 50.55a(a)(3) states: "Proposed alternatives to the requirements of paragraphs (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that: (i) The proposed alternatives would provide an acceptable level of quality and safety, or (ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety."

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that ISI examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The second 10-year ISI interval for Palo Verde Unit 2 began in May 1997 and the

ISI Code of record is the 1992 Edition with the 1992 Addenda. The components (including supports) may meet the requirements set forth in subsequent editions and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b) subject to the limitations and modifications listed therein and subject to commission approval.

3.0 RELIEF REQUEST NO. 31, PROPOSED ALTERNATIVE REPAIR FOR REACTOR COOLANT SYSTEM HOT LEG ALLOY 600 SMALL-BORE NOZZLES

3.1 Code Requirements

Sub-article IWA-4310 of ASME Section XI, 1992 Edition, 1992 Addenda states in part that the "defects shall be removed or reduced in size in accordance with this Paragraph."

The remaining portion of the flaw left in service requires flaw characterization as stated in IWA-3300 and successive examinations as stated in IWB-2420.

3.2 Licensee's Code Relief Request and its Proposed Alternative

The licensee proposed alternatives to the required flaw characterization (IWA-3300) and successive inspections (IWB-2420). The licensee will not be removing the remnant sleeve or its attachment weld.

In lieu of fully characterizing/sizing the potentially existing cracks, the licensee assumed worst case cracks in the Alloy 600 base and weld material and used the methodology presented in NRC approved Westinghouse Topical Report (TR) WCAP-15973-P, Revision 01, "Low-Alloy Steel Component Corrosion Analysis Supporting Alloy 600/690 Nozzle Repair Program," to support the request.

The licensee further evaluated the assumptions made to support this relief request using appropriate flaw evaluation rules of ASME Section XI and determined that the results demonstrate compliance with ASME Code Section XI criteria for the expected 40 years of plant life. As a result, the licensee is also requesting relief from the successive inspections required by IWB-2420.

3.3 Components for which Relief Is Requested

This relief request applies to 10 Palo Verde Unit 2 Alloy 600 small-bore reactor coolant system hot leg nozzles classified as ASME Code Section XI, Class 1, component number B9.32.

3.4 Licensee's Basis for Proposed Alternative

3.4.1 Introduction

During fabrication of the reactor coolant system (RCS) piping, Alloy 600 small-bore nozzles were welded to the interior of the RCS hot leg. Industry experience has shown that cracks may develop in the nozzle or in the weld metal joining the nozzles to the reactor coolant pipe and lead to leakage for the reactor coolant fluid. The cracks are caused by primary water stress corrosion cracking (PWSCC).

The original design of each Palo Verde unit RCS contained a total of twenty-seven (27) Alloy 600 small-bore hot leg penetrations. These penetrations include pressure taps, sampling line, and RTD thermowell nozzles. During the Palo Verde Unit 2 12th refueling outage, the licensee has scheduled the replacement of 10 Alloy 600 small-bore hot leg nozzles.

The total removal of all Alloy 600 small-bore nozzle and/or Alloy 82/182 weld material would require accessing the internal surface of the reactor coolant piping and grinding out the attachment weld and any remaining nozzle. Such an activity would result in high radiation exposure to the personnel involved. Grinding within the pipe would also expose personnel to other safety hazards such as confined space. The analysis in the Westinghouse TR WCAP-15973-P has shown that any cracks in the nozzle or attachment weld and vessel/piping carbon steel base metal will not affect structural integrity or propagate through the reactor coolant pressure boundary; therefore, there is no increase in the level or quality or safety as a result of removing the nozzle or the attaching weld metal.

3.4.2 Licensee's Basis

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee proposed alternatives to the flaw characterization (IWA-3300) and successive inspections (IWB-2420) requirements of the ASME Code Section XI. The licensee will not be removing the remnant sleeve or its attachment weld.

In lieu of fully characterizing/sizing the potentially existing cracks, the licensee assumed worst case cracks in the Alloy 600 base and weld material and used the methodology presented in NRC approved Westinghouse TR WCAP-15973-P, Revision 01, for determining the following:

1. The overall general/crevice corrosion rate for the internal surfaces of the low-alloy or carbon steel materials that will now be exposed to the reactor coolant and for calculating the amount of time the ferritic portions of the vessel or piping would be acceptable if corrosive wall thinning had occurred.

2. The thermal-fatigue crack-growth life of existing flaws in the Alloy 600 nozzles and/or Alloy 182/82 weld material into the ferritic portion of the vessels or piping.

3. Acceptable bases and arguments for concluding that unacceptable growth of the existing flaw by stress corrosion into the vessel or piping is improbable.

The licensee has reviewed the bases and arguments presented in TR WCAP-15973-P for the overall general/crevice corrosion rate, thermal-fatigue crack-growth life of existing flaws, and the bases for concluding that growth of the existing flaw by stress corrosion into the vessels or piping is improbable. The licensee finds that these bases and arguments apply to the replacement of the Palo Verde Unit 2 hot leg small-bore nozzles. The licensee has evaluated these assumptions using appropriate flaw evaluation rules of Section XI and determined that the results demonstrate compliance with ASME Code Section XI criteria for the expected 40 years of plant life. As a result, the licensee is also requesting relief from the successive inspections required by IWB-2420.

The licensee has determined that the proposed alternatives will provide an acceptable level of quality and safety and are within the analysis boundaries provided in TR WCAP-15973-P, Revision 01, by answering the following requirements set forth by NRC letter dated January 12, 2005, “Final Safety Evaluation For Topical Report WCAP-15973-P, Revision 01.”

3.4.2.1 General Corrosion Assessment

Licensees seeking to use the methods of Westinghouse TR WCAP-15973-P, Revision 01, will need to perform the following plant specific calculations in order to confirm that the ferritic portions of the vessels or piping within the scope of the TR will be acceptable for service throughout the licensed lives of their plants (40 years if the normal licensing basis plant life is used or 60 years if the facility is expected to be approved for extension of the operating license):

NRC Requirement 1

Calculate the minimum acceptable wall thinning thickness for the ferritic vessel or piping that will adjoin to the mechanical nozzle seal assembly (MNSA) repair or half-nozzle repair.

APS Response

Section 2.4 of the TR, determined the maximum allowable hole size relative to (1) the reduction in the effective weld shear area, and (2) the required area of reinforcement for the nozzle bore holes.

The maximum corroded hole diameter identified in the TR has been verified to apply to Palo Verde Unit 2. As for the second hole size, Palo Verde Unit 2 was used in the TR as one of the limiting hot leg pipe nozzles.

NRC Requirement 2

Calculate the overall general corrosion rate for the ferritic materials based on the calculational methods in the TR, the general corrosion rates listed in the TR for normal operations, startup conditions (including hot standby conditions), and cold shutdown conditions, and the respective plant-specific times (in-percentage of total plant life) at each of the operating modes.

APS Response

The assumptions in the TR analysis, regarding times at each of the operation modes, are as follows:

- Normal Operation: 88%,
- Startup Condition - 2%,
- Cold Shutdown Condition - 10%

APS has reviewed the operating history for PVNGS Unit 2 from when the first hot leg nozzle repair was implemented and has determined the percentage of total plant time spent at each of the operating modes as follows:

- Normal Operations - 90.22%,
- Startup Conditions - 1.33%,
- Cold Shutdown Conditions - 8.44%
  (PVNGS Technical Specifications Table 1.1-1 defines Cold Shutdown as a cold leg temperature of #210EF)

The most limiting operating conditions identified by the TR analysis are Cold Shutdown (10%) and Start-up (2%). The expected percentages of plant time for U2 in these limiting conditions are 8.44% and 1.33% respectively, which are lower than the TR analysis values. Using the U2 percentages and Equation No.1 of the TR, the calculated corrosion rate (CR) for PVNGS Unit 2 is shown below:

- CR = (0.9022)(0.4 mpy) + (.0133)(19.0 mpy) +(0.0844)(8.0 mpy) = 1.290 mpy

  mpy = mills per year

Thus, the projected corrosion rate for PVNGS Unit 2 does not exceed the TR corrosion rate of 1.53 mpy. Since the assumptions stated in the TR are not exceeded, a revised analysis is not required.

<u>NRC Requirement 3</u>

Track the time at cold shutdown conditions to determine whether this time does not exceed the assumptions made in the analysis. If these assumptions are exceeded, the licensees shall provide a revised analysis to the NRC, and provide a discussion on whether volumetric inspection of the area is required.

<u>APS Response</u>

APS has confirmed, as stated in response to Question 4.1-2 [Condition 2 above] that from the time of half nozzle implementation until now, the plant percentage times during the start-up and cold shutdown conditions do not exceed the TR analysis values. APS has committed to tracking this parameter (see attachment 2) [of the licensee's letter dated March 25, 2005].

<u>NRC Requirement 4</u>

Calculate the amount of general corrosion-based thinning for the vessels or piping over the life of the plant, as based on the overall general corrosion rate calculated in Step 2 and the thickness of the ferritic vessel or piping that will adjoin to the MNSA repair or half-nozzle repair.

APS Response

The Unit 2 corrosion rate (1.290 mpy) is used to calculate the amount of general corrosion over a 60-year period.

Corrosion = (0.001290 inch/year) (60 years)
= 0.0774 inch (radially, relative to penetration)
= 0.1548 inch (diametrically, relative to penetration)

NRC Requirement 5

Determine whether the vessel or piping is acceptable over the remaining life of the plant by comparing the worst case remaining wall thickness to the minimum acceptable wall thickness for the vessel or pipe.

APS Response

Diameter of penetration in 60 years = (0.1548 inch) + (1.120 inch) = 1.275 inch
Allowable diameter in 60 years = 1.280 inch

Allowable bore diameter will not be exceeded over the remaining life of the plant including life extension. Note that 60 years is considered to begin from original plant life, not at the time of repair.

3.4.2.2 Thermal-Fatigue Crack Growth Assessment

Licensees seeking to reference this TR for future licensing applications need to demonstrate that:

NRC Requirement 1

The geometry of the leaking penetration is bounded by the corresponding penetration reported in Calculation Report CN-CI-02-71, Revision 01.

APS Response

The geometry of the leaking penetration identified in [Westinghouse Report CN-CI-02-71, Rev.1, "Summary of Fatigue Crack Growth Evaluation Associated with Small Diameter Nozzles in CEOG Plants", dated March 31, 2004,] and the PVNGS nozzle geometry is compared below.

	Calc	PVNGS
Base metal thickness:	3.75 in	3.75 in
Inside radius to base metal:	21 in	21 in
Cladding thickness:	0.25 in	0.19 in

Westinghouse has provided APS a plant specific calculation [in a letter dated April 14, 2005] using PVNGS geometry. This calculation evaluates the crack growth for the APS specific hot leg borehole geometry and concludes that the final crack sizes computed for Palo Verde specific dimensions do not impact the conclusions of the original referenced calculation.

Table 1: Hot Leg Piping Crack Dimensions from CN-CI-02-71 Rev 01
(Borehole Diameter Used is 0.997")

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 2: Hot Leg Piping Crack Dimensions using PVNGS Dimensions
(Borehole Diameter Used is 1.120")

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

It can be seen by comparing the final crack sizes in Tables 2 with those in Table 1 and those reported in References 1 and 2 [in the licensee's letter dated March 25, 2005] that the effect of the change in the initial flaw depth from 0.938" to 0.950" and in the borehole diameter from 0.997" to 1.120" on the final crack sizes is very small and considered insignificant. Final crack sizes computed with the Palo Verde specific dimensions do not impact the conclusions made in References 1 and 2 [in the licensee's letter dated March 25, 2005]. The symbol > used under the maximum allowable crack sizes in the above tables is to be interpreted as the crack sizes which are still stable under the hot leg applied loading.

<u>NRC Requirement 2</u>

The plant-specific pressure and temperature profiles in the pressurizer water space for the limiting curves (cooldown curves) do not exceed the analyzed profiles shown in Figure 6-2 (a) of Calculation Report CN-CI-02-71, Revision 01, as stated in Section 3.2.3 of the TR Safety Evaluation (SE).

<u>APS Response</u>

APS is not requesting relief from the ASME requirements for the pressurizer in this request.

NRC Requirement 3

The plant-specific Charpy USE data shows a USE value of at least 70 ft-lb to bound the USE value used in the analysis. If the plant-specific Charpy USE data does not exist and the licensee plans to use Charpy USE data from other plants' pressurizers and hot-leg piping, then justification (e.g., based on statistical or lower bound analysis) has to be provided.

APS Response

The request of USE data is not applicable to PVNGS Unit 2 since elastic-plastic fracture mechanics was not applied to the hot leg nozzles in the TR. Furthermore, Palo Verde Unit 2 is bounded by the linear elastic fracture mechanics analysis in Calculation Report CN-CI-02-71, Revision 01, since the Unit 2 hot leg pipe RT_{ndt} is 20EF versus the 30EF value used in the TR.

3.4.2.3 Stress Corrosion Crack Growth Assessment

Licensees seeking to implement MNSA repairs or half-nozzle replacements may use the Westinghouse Owners Group's (WOG's) stress corrosion assessment as the bases for concluding that existing flaws in the weld metal will not grow by stress corrosion if they meet the following conditions:

NRC Requirement 1

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 ppb for dissolved oxygen, 150 ppb for halide ions, and 150 ppb for sulfate ions.

APS Response

A review of plant chemistry records show that the halide /sulfate concentrations levels have been maintained below 150 ppb for chloride and sulfate and below 100 ppb for fluoride over the last two operating cycles. Oxygen levels are maintained below 10 ppb during power operation and below 100 ppb during plant startups [RCS temperature >250F]. There is no oxygen limit when the RCS temperature is below 250F.

During startup, hydrogen overpressure is established when the RCS is > 400 degrees F for crud management. 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 TR with respect to stress corrosion cracking, applies to PVNGS.

NRC Requirement 2

During the outage in which the half-nozzle or MNSA repairs are scheduled to be implemented, licensees adopting the TR's stress corrosion crack growth arguments will need to review their plant-specific RCS coolant chemistry histories over the last two operating cycles for their plants, and confirm that these conditions have been met over the last two operating cycles.

APS Response

The review identified in the response above was completed in March 2005, prior to the upcoming U2 outage.

3.4.2.4 Other Considerations

The requirements contained in Section 4.0 of the staff's final SE for the TR WCAP-15973-P, Revision 01, must be addressed, along with the following, when this TR is used as the basis for the corrosion and fatigue crack growth evaluation when implementing a half-nozzle or MNSA repair:

NRC Requirement 1

Licensees using the MNSA repairs as a permanent repair shall provide resolution to the NRC concerns addressed in the NRC letter dated December 8, 2003, from H. Berkow to H. Sepp (ADAMS Accession No. ML033440037) concerning the analysis of the pressure boundary components to which the MNSA is attached, and the augmented inservice inspection program.

APS Response

APS is not currently planning on using a MNSA as a permanent repair.

NRC Requirement 2

Currently, half-nozzle and MNSA repairs are considered alternatives to the ASME Code, Section XI. Therefore, licensees proposing to use the half-nozzle and MNSA repairs shall submit the required information contained in TR WCAP-15973-P, Revision 01, by the conditions of this SE, to the NRC as a relief request in accordance with 10 CFR 50.55a.

APS Response

This letter provides APS' response to the conditions of the SE as a relief request in accordance with 10 CFR 50.55a.

4.0 REGULATORY COMMITMENTS

The following table identifies those new actions committed to by APS through relief request number 31.

Regulatory Commitment	Due Date	Tracking #
APS commits to continue to track the time at cold shutdown conditions against the assumptions made in the corrosion analysis to assure that the allowable bore diameter is not exceeded over the life of the plant. If the analysis assumptions are exceeded, APS shall provide a revised analysis to the NRC and provide a discussion on whether volumetric inspection of the area is required.	Active - ongoing (no due date)	RCTSAI 2782964
APS will reconcile the Westinghouse WCAP-15973-P Rev. 01 analysis with the non-Westinghouse analysis used to support the previous repairs of RCS hot leg Alloy 600 small-bore nozzles. When completed, APS will provide a relief request to support the previously replaced RCS hot leg nozzles in all three PVNGS units.	July 29, 2005	RCTSAI 2782958

5.0 TECHNICAL EVALUATION

During the Palo Verde Unit 2 12th refueling outage, the licensee has scheduled the replacement of 10 Alloy 600 small-bore hot leg nozzles. The licensee will perform a half-nozzle repair on each of these nozzles. This action by the licensee is considered by the NRC as a proactive approach to address PWSCC susceptibility of these Alloy 600 components in the RCS.

The licensee is requesting relief from Sub-article IWA-4310 of ASME Code Section XI, 1992 Edition, 1992 Addenda which states in part that the "defects shall be removed or reduced in size in accordance with this Paragraph." The licensee proposed alternatives to the required flaw characterization (IWA-3300) and successive inspections (IWB-2420). The licensee's alternative is to not fully characterize/size the existing flaws, rather assume a worst case flaw in the Alloy 600 base and weld material and use the methodology presented in Westinghouse TR WCAP-15973-P, Revision 01, for determining the following:

1. The overall general/crevice corrosion rate for the internal surfaces of the low-alloy or carbon steel materials that will now be exposed to the reactor coolant and for calculating the amount of time the ferritic portions of the vessel or piping would be acceptable if corrosive wall thinning had occurred.

2. The thermal-fatigue crack-growth life of existing flaws in the Alloy 600 nozzles and/or Alloy 82/182 weld material into the ferritic portion of the vessels or piping.

3. Acceptable bases and arguments for concluding that unacceptable growth of the existing flaw by stress corrosion into the vessel or piping is improbable.

In a letter from the NRC to the WOG dated January 12, 2005, the NRC provided its final SE for the TR WCAP-15973-P, Revision 01. The NRC staff's assessment of TR WCAP-15973-P, Revision 01, indicated that the WOG's methods and analysis in the TR were generally acceptable - specifically, that TR WCAP-15973-P, Revision 01, provided sufficient basis to accomplish the above objectives with respect to implementing the half-nozzle repair. The NRC staff found that licensees could use the methods of the TR as a basis, provided several plant specific questions were submitted to the NRC for review in the areas of general corrosion assessment, thermal-fatigue crack growth assessment, stress corrosion cracking growth assessment, and a few other considerations. Through the licensee's relief request number 31, APS provided the required responses to these questions as detailed in Section 3.4 above.

In the area of general corrosion assessment, the NRC staff finds the licensee's responses met the requirements of the NRC's final SE for TR WCAP-15973-P, Revision 01. The minimum acceptable wall thinning thickness for the ferritic piping that will adjoin to the half-nozzle repair was used in the TR as one of the limiting hot leg pipe nozzles. The overall general corrosion rate was calculated in accordance with the methodology of TR WCAP-15973-P, Revision 01, with plant specific operating history for Palo Verde Unit 2 to be 1.290 mpy. The licensee has committed to tracking the time at cold shutdown conditions. The amount of general corrosion-based thinning for the piping over the life of the plant was calculated to be 0.1548-inch diametrically, relative to the penetration. The piping is acceptable over the remaining life of the plant as the worst case remaining wall thickness (1.275-inch) is within the minimum acceptable wall thickness for the pipe (1.280-inch) over a 60-year period. Therefore, in the area of general corrosion assessment, the NRC staff finds the licensee's proposed alternative acceptable.

In the area of thermal-fatigue crack growth assessment, the NRC staff finds the licensee's responses met the requirements of the NRC's final SE for TR WCAP-15973-P, Revision 01. While the geometry of the repaired penetration is not bounded by the corresponding penetration reported in Calculation Report CN-CI-02-71, Revision 01, Westinghouse provided the licensee a plant specific calculation using Palo Verde geometry which shows sufficient margin of final flaw size to the allowable axial and circumferential flaw sizes of TR WCAP-15973-P, Revision 01. The plant-specific pressure and temperature profiles were not required for this relief request. The plant-specific Charpy USE data was not applicable. Therefore, in the area of thermal-fatigue crack growth assessment, the NRC staff finds the licensee's proposed alternative acceptable.

In the area of stress corrosion cracking growth assessment, the NRC staff finds the licensee's responses met the requirements of the NRC's final SE for TR WCAP-15973-P, Revision 01. The licensee demonstrated that a sufficient level of hydrogen overpressure is implemented for the RCS, and the contaminant concentrations in the reactor coolant are typically maintained at levels below 10 ppb for dissolved oxygen, 150 ppb for halide ions, and 150 ppb for sulfate ions. The licensee identified that there is no oxygen limit when the RPS temperature is below 250EF and during startup oxygen levels are maintained below 100 ppb. However, both conditions are addressed in the final SE and TR WCAP-15973-P, Revision 01, with the increased conservative corrosion rates for startup and low temperature oxygenated conditions. If additional laboratory or field data becomes available that invalidates the general corrosion rate values for normal operations, startups, and cold shutdown conditions contained in TR WCAP-15973-P, Revision 01, the WOG will add an addendum to the TR that evaluates the impact of the new data of the corrosion rate values for normal operations, startups, and cold shutdown conditions and that provides a new overall general corrosion rate assessment for the ferritic components under assessment. As well, the licensee also completed a review in March 2005 of their plant-specific RCS coolant chemistry histories over the last two operating cycles and confirmed that these chemistry conditions have been met over the last two operation cycles. Therefore, in the area of stress corrosion cracking growth assessment, the NRC staff finds the licensee's proposed alternative acceptable.

In the area of other considerations, the NRC staff finds the licensee's responses met the requirements of the NRC's final SE for TR WCAP-15973-P, Revision 01. The licensee provided the information required by the NRC final SE report for TR WCAP-15973-P, Revision 01, as noted above as a relief request and the information provided was sufficient to meet the requirements for Palo Verde Unit 2 to use TR WCAP-15973-P, Revision 01, as a basis for relief from Sub-article IWA-4310, required flaw characterization (IWA-3300) and successive inspections (IWB-2420) of ASME Code Section XI, 1992 Edition, 1992 Addenda. Therefore, in the area of other considerations, the NRC staff finds the licensee's proposed alternative acceptable.

The licensee requested that this relief request remain in effect for the remainder of plant life. In general, ISI relief requests are granted only for the plant's current 10-year ISI interval. Further, NRC staff calculations indicate that increasing the total percentage plant time in the cold shutdown condition by 0.56 percent from the licensee-reported 8.44 percent to 9 percent would cause the worst case remaining wall thickness to equal the minimum acceptable wall thickness for the hot leg RCS pipe over the calculated 60 year interval. As noted in the NRC's final SE of TR WCAP-15973-P, Revision 01, additional laboratory or field data may become available that could invalidate the general corrosion rate values contained in TR WCAP-15973-P, Revision 01. Given the small increase in cold shutdown time that results in the worst case remaining wall thickness equaling the minimum acceptable thickness for the hot leg RCS pipe, and the limited data for general corrosion rates, the NRC staff finds that there is insufficient margin to grant the licensee's relief request number 31 for the remainder of plant life. However shorter term calculations, such as over a 23 year interval, indicate that total percentage of time the plant would have to be in the cold shutdown condition would have to increase by 37 percent to reach the minimum acceptable wall thickness. Therefore, the NRC staff finds that there is sufficient margin to absorb small changes in cold shutdown condition time and corrosion rates, for the remainder of the second 10-year ISI interval, as well as for the third and fourth 10-year ISI intervals.

The NRC staff's review of the licensee's responses in the areas of general corrosion assessment, thermal-fatigue crack growth assessment, stress corrosion cracking growth assessment, and other considerations, supports the licensee's use of the TR WCAP-15973-P, Revision 01, as a basis for relief request number 31. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i) the NRC staff finds relief request number 31 will provide an acceptable level of quality and safety for Palo Verde Unit 2, for the second, third and fourth 10-year ISI intervals with the regulatory commitments listed in Section 4.0 above.

6.0 CONCLUSION

The NRC staff has reviewed the licensee's proposed relief request number 31, as an alternative repair relief request for 10 Alloy 600 small-bore reactor coolant system hot leg nozzles in lieu of the ASME Code Section XI requirements for required flaw examinations and successive inspections, for the components listed above. Based on the NRC staff's review of the licensee's proposed justification, the NRC staff concludes that granting relief pursuant to

10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the licensee's alternative repair as stated in relief request number 31 is authorized for Palo Verde Unit 2, for the second, third, and fourth 10-year ISI intervals with the licensee accepted regulatory commitments listed in Section 4.0 above.

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

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Date: 5/5/05

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