UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 19, 2019

Mr. Robert S. Bement
Executive Vice President Nuclear/
Chief Nuclear Officer
Arizona Public Service Company
P.O. Box 52034, Mail Station 7602
Phoenix, AZ 85072-2034

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNIT 3 – RELIEF REQUESTS 60 AND 61 FOR THE FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL, REQUEST FOR RELIEF FROM THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS – HALF-NOZZLE REPAIRS (EPID L-2018-LLR-0111 AND EPID L-2018-LLR-0112)

Dear Mr. Bement:

By letter dated August 17, 2018, Arizona Public Service Company (the licensee) submitted Relief Requests (RRs) 60 and 61 to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," for Palo Verde Nuclear Generating Station (PVNGS), Unit 3 fourth 10-year inservice inspection (ISI) interval.

Specifically, the licensee requested to renew the previously approved RRs 52 and 54 that addressed the alternative repairs of a reactor pressure vessel bottom-mounted instrument nozzle, and a reactor coolant pump 2A pressure instrument nozzle, respectively. The proposed RRs 60 and 61 correspond to RRs 52 and 54

In the previous NRC-approved RRs 52 and 54, the licensee provided, and the NRC staff reviewed stress analysis, flaw evaluation, fatigue crack growth evaluation, fracture mechanic evaluation, vibration assessment, weld design, stress-corrosion cracking assessment, loose parts evaluation, and general corrosion assessment. The NRC staff verified that these analysis and assessments have been performed for the life of the plant, and the staff finds that they are still valid. Therefore, the structural integrity of the repaired instrument nozzles will be maintained for remainder of the fourth ISI interval.

The NRC staff further concludes that the proposed alternative previously approved by the NRC, for the repair of the subject pressure instrument nozzles, provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes, as set forth in the enclosed safety evaluations, that the licensee has adequately addressed all of the regulatory requirements set forth in Title 10 of the *Code of Federal Regulations* Section 50.55a(z)(1). Therefore, the NRC authorizes the use of RRs 60 and 61 at PVNGS, Unit 3 until the end of the fourth ISI interval, which is currently scheduled to end on January 10, 2028.

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

If you have any questions, please contact the Project Manager, Siva P. Lingam, at 301-415-1564 or via e-mail at Siva.Lingam@nrc.gov.

Sincerely,

Robert J. Pascarelli, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. STN 50-530

Enclosures:
1. Safety Evaluation for RR 60
2. Safety Evaluation for RR 61

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST 60

REGARDING HALF-NOZZLE REPAIR OF REACTOR PRESSURE

VESSEL BOTTOM-MOUNTED INSTRUMENTATION NOZZLE

FOR THE FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION, UNIT 3

DOCKET NO. STN 50-530

1.0 INTRODUCTION

By letter dated August 17, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18229A335), Arizona Public Service Company (the licensee) requested U.S. Nuclear Regulatory Commission (NRC) relief from certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," IWA-4000, "Repair/Replacement Activities." In Relief Request (RR) 60, the licensee requested that the previously repaired reactor pressure vessel (RPV) bottom-mounted instrumentation (BMI) Nozzle No. 3 and its attachment J-groove weld by the "half-nozzle" technique be remained in service in the fourth 10-year inservice inspection (ISI) interval of the Palo Verde Nuclear Generating Station (PVNGS), Unit 3.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), the licensee proposed an alternative "half-nozzle" repair for the degraded Alloy 600/82/182 BMI nozzle and attachment weld on the basis that the alternative provides an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

Components (including supports) that are classified as ASME Code Class 1, Class 2, and Class 3 must meet the requirements in 10 CFR 50.55a(g)(4), "Inservice inspection standards requirement for operating plants," throughout the service life of a boiling-water reactor or pressurized-water reactor (PWR). The exception is the design and access provisions and preservice examination requirements set forth in Section XI of editions and addenda of the ASME Code that become effective subsequent to editions specified in paragraphs (g)(2) and (3) of 10 CFR 50.55a, which are incorporated by reference in

paragraph (a)(1)(ii) of 10 CFR 50.55a to the extent practical within the limitations of design, geometry, and materials of construction of the components.

Pursuant to 10 CFR 50.55a(g)(4)(ii), "Applicable ISI Code: Successive 120-month intervals," "[i]nservice examination of components and system pressure tests conducted during successive 120-month inspection intervals must comply with the requirements of the latest edition and addenda of the ASME Code incorporated by reference in paragraph (a) of [10 CFR 50.55a] 12 months before the start of the 120-month inspection interval (or the optional ASME Code Cases listed in NRC Regulatory Guide 1.147, when using ASME Code, Section XI, ... as incorporated by reference in paragraph (a)(3)(ii)...of [10 CFR 50.55a], subject to the conditions listed in paragraph (b) of [10 CFR 50.55a]."

Pursuant to 10 CFR 50.55a(g)(6)(ii)(E), "Augmented ISI requirements: Reactor coolant pressure boundary visual inspections," "(1) All licensees of pressurized water reactors must augment their inservice inspection program by implementing ASME Code Case N-722-1, ["Additional Examinations for PWR Pressure Retaining Welds in Class 1 Components Fabricated With Alloy 600/82/182 Materials, Section XI, Division 1,"] subject to the conditions specified in paragraphs (g)(6)(ii)(E)(2) through (4) of [10 CFR 50.55a]. The inspection requirements of ASME Code Case N-722-1 do not apply to components with pressure retaining welds fabricated with Alloy 600/82/182 materials that have been mitigated by weld overlay or stress improvement."

Pursuant to 10 CFR 50.55a(z), "Alternatives to codes and standards requirements," "[a]lternatives to the requirements of paragraphs (b) through (h) of [10 CFR 50.55a] or portions thereof may be used when authorized by the Director, Office of Nuclear Reactor Regulation, or Director, Office of New Reactors, as appropriate. A proposed alternative must be submitted and authorized prior to implementation. The applicant or licensee must demonstrate that: (1) 'Acceptable level of quality and safety,' the proposed alternative would provide an acceptable level of quality and safety; or (2) 'Hardship without a compensating increase in quality and safety,' compliance with the specified requirements of [10 CFR50.55a] would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety."

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the NRC to authorize the alternative requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 The Licensee's Relief Request

Background

RR 60 is related to two previous relief requests (RR 51 (ADAMS Accession No. ML13317A071) and RR 52 (ADAMS Accession No. ML14142A029)). The previous relief requests addressed the repair of leaking RPV BMI Nozzle No. 3 by the alternative "half nozzle" technique in the third 10-year ISI interval during the October 2013 refueling outage. The alternative repair by the "half nozzle" technique permitted the remnant of the original Alloy 600 nozzle and the original Alloy 82/182 attachment weld containing cracks to remain in service. Alloy 600/82/182 materials are susceptible to the primary water stress corrosion cracking (PWSCC). In addition, the design configuration of the "half nozzle" repair potentially allowed the

RPV bottom head base material to be exposed to the borated reactor coolant. In the NRC safety evaluations dated April 10, 2014 (ADAMS Accession No. ML14093A407), and March 30, 2015 (ADAMS Accession No. ML15079A006), the NRC authorized the alternative "half-nozzle" repair of the RPV BMI Nozzle No. 3 for the third 10-year ISI interval. The licensee submitted RR 60 to support the same relief for the fourth 10-year ISI interval.

In 2013, the licensee found evidence of leakage in the annulus of RPV BMI Nozzle No. 3 during the augmented inspection performed on the vessel bottom head in accordance with ASME Code Case N-722-1. To determine the source and root cause of leakage, the licensee performed the ultrasonic testing (UT) and the eddy current testing (ECT) from the inside diameter (ID) of BMI Nozzle No. 3. The UT identified and characterized a group of axially-oriented flaws at the outside diameter (OD) of the nozzle. The UT could not reliably detect and characterize flaws beyond the nozzle OD surface that may grow into the J-groove dissimilar metal (DM) weld. The ECT did not identify any surface-connected flaws on the nozzle ID. No circumferential flaws were identified in the nozzle. The licensee took a boat sample from BMI Nozzle No. 3 and performed metallurgical analysis to evaluate the root cause of cracking, which was determined to be the result of PWSCC. To evaluate the extent of condition, the licensee inspected the nozzle bore of each of the remaining 60 BMI nozzle penetrations by UT and ECT. No unacceptable indications were detected in the remaining 60 BMI nozzles.

ASME Code Component Affected

ASME Code Class 1 RPV BMI Nozzle No. 3 and the associated J-groove DM attachment weld are affected. This DM weld is classified as Item No. B15.80 in accordance with ASME Code Case N-722-1. The original BMI nozzle and its associated J-groove weld are made of Alloy 600/82/182 materials. The RPV bottom head is of low alloy steel. The BMI nozzle has a nominal outside diameter of 3 inches.

Applicable ASME Code Edition and Addenda

The Code of record for the fourth 10-year ISI interval is the 2013 Edition and no addenda of the ASME Code.

Duration of Relief Request

The licensee submitted RR 60 for the fourth 10-year ISI interval, which commenced on June 1, 2018, and is scheduled to end on January 10, 2028.

Applicable ASME Code Requirement

The ASME Code requirements applicable to this request originate in Articles IWB-2000, IWB-3000, and IWA-4000 of Section XI.

- Subparagraph IWB-2420(b), requires, in part, that "if a component is accepted for continued service in accordance with IWB-3132.3 or IWB-3142.4, the areas containing flaws or relevant conditions shall be reexamined during the next three inspection periods listed in the schedule of the Inspection Program of IWB-2400."

- Subparagraph IWB-3142.4, "Acceptance by Analytical Evaluation," requires, in part, that "[a] component containing relevant conditions is acceptable for continued service if an analytical evaluation demonstrates the component's acceptability."

- Subarticle IWB-3420, "Characterization," requires, in part, that "[e]ach detected flaw or group of flaws shall be characterized by the rules of IWA-3300 to establish the dimensions of the flaws."

- Paragraph IWA-4421, "General Requirements," requires, in part, that "[d]efects shall be removed or mitigated."

- Subparagraph IWA-4422.1(b), requires, in part, that "the defect removal area and any remaining portion of the defect may be evaluated and the component accepted in accordance with the appropriate flaw evaluation provisions of Section XI...."

Proposed Alternative

The licensee proposed that the previously repaired RPV BMI Nozzle No. 3 by the "half-nozzle" technique that left the cracks and PWSCC susceptible materials (i.e., the remnant of the original Alloy 600 BMI nozzle with its Alloy 82/182 J-groove attachment weld) in service to continue to remain in service in the fourth 10-year ISI interval. A brief summary of the proposed alternative "half nozzle" repair is as follows.

- The external portion of the original Alloy 600 BMI nozzle was cut outboard of the original fabrication partial penetration weld within the wall thickness of the RPV bottom head, and removed;

- The external cut section of Alloy 600 BMI nozzle was replaced with Alloy 690 nozzle;

- Alloy 52 weld pad was deposited on the exterior surface of the RPV bottom shell by the ambient temperature temper bead welding;

- Alloy 690 nozzle section was attached to the weld pad by the Alloy 52 weld;

- The new Alloy 52 weld and weld pad on the exterior surface of the RPV bottom head become the new reactor coolant pressure boundary (RCPB).

- The remainder of the original Alloy 600 BMI nozzle, including the original Alloy 82/182 J-groove weld containing cracks, remained in place without correction and subsequent inspections. The acceptability of leaving flaws in service without correction and subsequent examinations was demonstrated by the analytical evaluations. The remnant Alloy 600 nozzle and Alloy 82/182 weld will continue to have a structural function in support of the operability of the incore instrumentation cable.

- The remnant Alloy 600 BMI nozzle was physically separated from the Alloy 690 nozzle section and no longer performs a RCPB function. The acceptability of exposing a small area of the RPV base material to the reactor coolant as a result of design configuration of the nozzle repair was demonstrated by the corrosion analysis.

The new RCPB weld located on the exterior surface of the RPV bottom head will be examined in accordance with the applicable requirements of Sections III and XI of the ASME Code.

Basis for Use of Alternative

The licensee stated that the technical basis provided in previous RRs 51 and 52, for the "half-nozzle" repair of RPV BMI Nozzle No. 3, is applicable to the current RR 60. The "half-nozzle" repair of RPV BMI Nozzle No. 3 in 2013 remains, as previously, repaired and evaluated. All physical plant parameters identified in the analyses remain valid and bounding. The licensee's stress analyses, fracture mechanics and flaw growth evaluations, and corrosion assessments for the "half-nozzle" repair of BMI Nozzle No. 3 are documented in Attachments 1 through 6 of the previous RRs 51 and 52 (ADAMS Accession Nos. ML13317A071 and ML14142A029, respectively). The licensee's analyses previously demonstrated: (1) the acceptability of repair design, (2) assurance of the structural integrity of the RPV with flaws in remnant original nozzle and J-groove welds left in service, and (3) assurance of structural integrity of RPV base material exposed to reactor coolant, through the remainder of PVNGS, Unit 3 licensed operating life, which expires on November 25, 2047.

The licensee stated that it performed post-repair visual examinations of BMI Nozzle No. 3 in refueling outages 3R18 (April 2015) and 3R19 (October 2016). No unacceptable indications or leakage were identified. The licensee has complied with the augmented bare metal visual examinations of the RPV bottom head in accordance with ASME Code Case N-722-1 as mandated by 10 CFR 50.55a with conditions.

3.2 NRC Staff Evaluation

The NRC staff has evaluated RR 60 pursuant to 10 CFR 50.55a(z)(1). The NRC staff focuses on whether the licensee's proposed alternative repair accompanied with the plant-specific analyses (i.e., stress, fracture mechanics, crack growth, and corrosion analyses) provides an acceptable level of quality and safety. The NRC staff notes that the NRC previously reviewed the "half-nozzle" repair of RPV BMI Nozzle No. 3 in 2014 and accepted it for the licensed operating life, which expires on November 25, 2047 (ADAMS Accession Nos. ML14093A407 and ML15079A006, respectively). In its review of RR 60 for the fourth 10-year ISI interval, the NRC staff focuses on two aspects of the licensee's technical basis: (1) safety significance of leaving the flaws and PWSCC susceptible materials in service, and (2) safety significance of potentially exposing the RPV base material to borated reactor coolant. The NRC staff finds that, if these two technical bases are shown to provide reasonable assurance of structural integrity of RPV in the fourth 10-year ISI interval, the requirements of 10 CFR 50.55a(z)(1) will be met.

Safety Significance of Flaws Left in Service

In evaluating the licensee's technical basis for the proposed alternative repair, the NRC staff assessed the licensee's plant-specific analysis, which includes stress analysis, fatigue crack growth and fracture mechanic evaluations. These analyses serve as a technical basis to demonstrate that the existing cracks left in service and without subsequent examinations would not impact the structural integrity of the RPV. The NRC staff verified that:

- The licensee utilized finite element analysis (FEA) to calculate the stresses and welding residual stress (WRS) fields in the remnant BMI Nozzle No. 3 J-groove weld and adjacent materials. The licensee's FEA included: (1) modeling of as-designed geometry and materials of BMI nozzle, J-groove weld, buttering, RPV bottom head, and cladding;

(2) simulating of the heating and cooling of deposited weld passes; (3) simulating of welding heat generation; (4) simulating of deposition of weld buttering on the RPV base metal and J-groove weld passes over buttering; (5) simulating of post-weld heat treatment; (6) modeling of possible weld repair passes; and (7) simulating of hydrostatic test and cycling loads at operations. Specific to BMI Nozzle No. 3, the licensee's FEA modeling included the effects from the boat sample taken for the root cause analysis. The NRC staff notes the licensee's stress analysis is consistent with the industry guidance and modeling practice and, therefore, adequately predicts the WRS distributions at J-groove weld and adjacent materials.

- The licensee performed crack growth and fracture mechanics analyses to justify long term acceptance of leaving flaws in service and establish allowable service life. For these analyses, the licensee assumed an initial worst-case axial-radial crack in the original J-groove weld. The worst-case initial crack was postulated as such: (1) the entire J-groove weld is cracked, (2) the crack tip is at the interface between the J-groove weld buttering and the RPV base metal, and (3) the crack propagates into the RPV base metal by fatigue under plant-specific design transients and cycles. In addition, the licensee utilized the lower bound J-integral resistance curve from NRC Regulatory Guide 1.161 "Evaluation of Reactor Pressure Vessels with Charpy Upper-Shelf Energy Less Than 50 FT-LB" (ADAMS Accession No. ML003740038). The licensee's analysis showed that the flaw growth into the RPV base material is limited to 0.157 inch of 6.5-inch-thick reactor vessel. The NRC staff notes that the licensee followed the ASME Code, Section XI, flaw evaluations criteria, and showed that the calculated final flaw size meets the IWB-3600 safety margins, and the flaw remains stable for the remaining plant licensed operation to 2047.

- In addition, the licensee performed a flaw evaluation of the existing cracks identified in the remnant Alloy 600 nozzle. The licensee assumed the cracks would grow radially through the nozzle wall thickness and axially along the length of the remnant Alloy 600 nozzle due to fatigue and PWSCC. The licensee used the crack growth rates that are consistent with the ASME Code and industry guidance. The licensee's results showed that the growth of the axial-radial crack is not large enough to reach both ends of the nozzle before the plant license expiration in 2047 to generate loose parts. Therefore, the licensee's analysis provides assurance that the structural integrity of the nozzle will be maintained. The NRC staff finds that the licensee has adequately demonstrated that the generation of loose parts is unlikely during the licensed operating life.

Based on the above, the NRC staff determines that the licensee has demonstrated that the structural integrity of the RPV, with the repaired BMI Nozzle No. 3, will be maintained in the fourth 10-year ISI interval.

Safety Significance of Potential Corrosion of RPV Base Material

In its review, the NRC staff assessed the licensee's corrosion analysis, which is based on four assumptions that require plant-specific verification. The first two assumptions are related to plant operating conditions in terms of percentage of time at shutdown and start-up conditions. The third and fourth assumptions are related to plant chemistry controls. The NRC staff verified:

- The licensee tracks the percentage of time at both shutdown and start-up conditions by Engineering Study 13-MS-B041 "Alloy Steel Corrosion Analysis Supporting Alloy 600/690 Nozzle Repair/Replacement," which the licensee has implemented for the

"half-nozzle" repairs to other primary system components. The NRC staff finds that the first two assumptions of corrosion analysis for PVNGS, Unit 3, are met for the remainder of the plant licensed operation.

- The licensee maintains the reactor coolant chemistry by the Plant Chemistry Program in accordance with Electric Power Research Institute Pressurized Water Chemistry Guidelines and Plant Technical Requirements Manual. The NRC staff finds that the third and fourth assumptions of the corrosion analysis for the PVNGS, Unit 3, are met for the remainder of the plant licensed operation.

On the basis of licensee's plant-specific verifications of corrosion analysis, the NRC staff determines that the licensee's corrosion analysis is acceptable for the fourth 10-year ISI interval.

In summary, the NRC staff concludes that there is reasonable assurance that the remnant of the original RPV BMI Nozzle No. 3 and associated J-groove weld, including the flaws and PWSCC susceptible materials left in service, will not impact the structural integrity of the RPV or the RCPB.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the licensee's proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the licensee's proposed alternative RR 60 for PVNGS, Unit 3, for the fourth 10-year ISI interval that began on June 1, 2018, and is scheduled to end on January 10, 2028.

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

Principal Contributor: A. Rezai

Date: February 19, 2019

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST 61

REGARDING REPAIR OF REACTOR PRESSURE

INSTRUMENT NOZZLE AT REACTOR COOLANT PUMP 2A

FOR THE FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION, UNIT 3

DOCKET NO. STN 50-530

1.0 INTRODUCTION

By letter dated August 17, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18229A335), Arizona Public Service Company (APS, the licensee) submitted Relief Request (RR) 61 for the use of an alternative to certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," at Palo Verde Nuclear Generating Station (PVNGS), Unit 3.

The request for the fourth 10-year inservice inspection (ISI) interval seeks replacement of RR 54 (ADAMS Accession No. ML15300A218), submitted on October 22, 2015, and authorized by the U.S. Nuclear Regulatory Commission (NRC) staff for the third interval by letter dated June 23, 2016 (ADAMS Accession No. ML16172A038).

The request for RR 61, same as RR 54, would allow a completed ASME Code-compliant half-nozzle repair and a flaw evaluation as an alternative to the requirements of ASME Code, Section XI, IWA-4421, "General Requirements," for flaw removal and ASME Code, Section XI, IWB-2420, "Successive Inspections," for successive examinations, for the pressure instrument nozzle attached to the safe end of the suction side of Reactor Coolant Pump (RCP) 2A.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(z)(1), the licensee proposed a completed half-nozzle repair and flaw evaluation as an alternative repair for the degraded pressure instrument nozzle attached to the safe end of the suction side of RCP 2A in lieu of flaw removal in accordance with the ASME Code, Section XI, IWA-4421. In addition, the alternative proposes to forgo successive examinations of the remaining flaw, as required by ASME Code, Section XI, IWB-2420. The licensee requested

to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), "Inservice inspection standards requirement for operating plants," ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components.

Section 50.55a(z) of 10 CFR, "Alternatives to codes and standards requirements," states, in part, that alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the NRC, if (1) the proposed alternative would provide an acceptable level of quality and safety or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the Commission to authorize the alternative requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 The Licensee's Relief Request

ASME Code Component Affected

The affected component is ASME Class 1, RCP 2A suction pressure instrument nozzle in the cold leg. The nozzle is attached to the safe end of the RCP 2A. The examination category of the subject nozzle is ASME Code Case N-722-1 ["Additional Examinations for PWR Pressure Retaining Welds in Class 1 Components Fabricated With Alloy 600/82/182 Materials, Section XI, Division 1,"], Class 1 pressurized-water reactor components containing Alloy 600/82/182. The examination Code item number is B15.205, cold-leg instrument connections of ASME Code Case N-722-1. In addition, the ASME Code, Section XI, Table IWB-2500-1, "Examination Category B-P, All Pressure Retaining Components," applies to the suction pressure instrument nozzle with respect to the pressure test program.

Applicable ASME Code Edition and Addenda

PVNGS, Unit 3 is currently in its fourth 10-year ISI interval, which commenced on January 11, 2018, and will end on January 10, 2028. The Code of record for the third 10-year ISI interval is the ASME Code, Section XI, 2001 Edition through 2003 Addenda. The Code of record for the fourth 10-year ISI interval is the ASME Code, Section XI, 2013 Edition. The licensee stated that it has verified that there have been no changes that impact the applicable Code requirements between the ASME Code Section XI 2001 Edition/2003 Addenda and 2013 Edition.

Applicable ASME Code Requirement

The ASME Code requirements applicable to this request originate in Articles IWA-4000 and IWB-2000 of Section XI.

- Paragraph IWA-4421, "General Requirements," of the ASME Code, Section XI, requires, in part, that "[d]efects shall be removed or mitigated."

- Subarticle IWB-2420 of the ASME Code, Section XI, requires that areas containing flaws or relevant indications in components that have been accepted for continued service, shall be reexamined during the next three inspection periods.

Licensee's Reason for the Request

The licensee stated that during the preparation and review of the ISI program documents for the fourth 10-year Interval, it was determined that RR 54 had only been previously approved for the third interval. This submittal requests the use of the same identified alternative for the fourth 10-year ISI Interval for PVNGS Unit 3. The licensee's submittal of RR 54 and supporting documentation were submitted in the following documents:

- ADAMS Package Accession No. ML15300A218 by letter dated October 22, 2015
- ADAMS Accession No. ML16147A092 by letter dated May 20, 2016

In RR 54, the licensee stated that during the boric acid program walkdowns at the beginning of the 18th refueling outage (denoted as 3R18) in spring 2015, the licensee detected leakage at the pressure instrument nozzle that is attached to the safe end on the suction side of RCP 2A. The licensee inspected the extent of condition of the remaining Unit 3 reactor coolant system (RCS) cold-leg instrument nozzles as required by ASME Code Case N-722-1 and found no other RCS pressure boundary leakage.

In RR 54, the licensee also stated that repair of the original RCP 2A instrument nozzle and associated J-groove weld would require removal of the RCP internals. Removing the RCP internals would allow access to the internal surface of the reactor coolant piping in order to grind out the attachment J-groove weld and repair or replace the remaining nozzle. The licensee further stated that such an activity would result in high radiation exposure to the personnel involved and present the additional risk of introducing foreign material into the RCS and reactor core. Additionally, ultrasonic testing examination of the remnant J-groove weld was not feasible because of its configuration and the restrictive access associated with the small bore of the instrument nozzle internal orifice.

The licensee proposed the completed ASME Code-compliant half-nozzle repair and a flaw evaluation as an alternative to the IWA-4421 requirements for flaw removal and IWB-2420 successive examination requirements. The current proposed alternative, RR 61, seeks approval of the completed repair for the remainder of the PVNGS, Unit 3 fourth 10-year ISI interval, which expires on January 10, 2028.

Proposed Alternative and Basis for Use

In its letter dated August 17, 2018, the licensee stated, in part, that:

> Pursuant to 10 CFR 50.55a(z)(1), APS requests NRC approval of RR 61, which proposes an alternative to the ASME Code requirements of Section XI related to evidence of leakage identified in a Unit 3 RCP 2A suction side instrument nozzle. Approval of this request was previously granted by the NRC for the half-nozzle

repair and flaw evaluation as an alternative to the ASME Section XI requirements for flaw removal of IWA-4421 and successive examinations of IWB-2420. ... The half-nozzle repairs performed on the Unit 3 RCP 2A instrument nozzle remain as previously repaired and evaluated. All physical plant parameters identified in the flaw evaluation and its supporting documentation remain valid and bounding. The half-nozzle repair and accompanying flaw evaluation have been analyzed for the licensed operating life of the plant and have previously been determined to provide an acceptable level of quality and safety.

Since the time that the half-nozzle repair was implemented in refueling outage 3R18, the 2A RCP instrument nozzle has been visually inspected in refueling outage 3R19 (October of 2016). No indications or changes have been identified by the visual examinations post repair. Examinations will continue per the methods and frequencies described in Code Case N-722-1, which is required to be implemented per 10 CFR 50.55a. The unit heat-up and cooldown histories have been updated in plant documents consistent with the underlying corrosion analyses.

3.2 NRC Staff Evaluation

The NRC staff verified that there have been no changes that impact the applicable Code requirements between the ASME Code Section XI, 2001 Edition/2003 Addenda and the 2013 Edition.

In RR 54, the licensee provided and the NRC staff reviewed stress analysis, flaw evaluation, vibration assessment, weld design, stress-corrosion cracking assessment (by using WCAP-15973-P, Revision 1), loose parts evaluation, and general corrosion assessment for its relief request. The NRC staff verified that these analysis and assessments have been performed for the life of the plant, and the staff finds that they are still valid.

The NRC finds that the licensee's alternative to allow a defect to remain in the remnant J-groove weld and nozzle, and to forego future inspections, is acceptable because (1) the original RCP 2A suction pressure instrument nozzle and weld that contain the defect(s) no longer perform a pressure retaining function; (2) the new half nozzle and pressure retaining weld on the outside diameter on the RCP 2A suction safe end meet all ASME Code requirements; (3) flaw(s) in the remnant nozzle and J-groove weld have been analyzed to show that the flaw(s) will not grow to an unacceptable size into the carbon steel safe end material; (4) flaw(s) in the remnant nozzle and J-groove weld have been analyzed to show that the flaw(s) will not grow into the carbon steel safe end material due to stress-corrosion cracking; (5) the carbon steel nozzle bore has been appropriately evaluated for the effects of general corrosion; and (6) in the unlikely event that portions of the remnant weld or nozzle should fall into the RCS flow, the licensee's evaluation shows that the postulated loose parts will have no adverse impact on the RCS and connected structures, systems, and components.

4.0 CONCLUSION

The NRC staff has reviewed the licensee's submittal and concludes that the proposed repair will restore the primary system pressure boundary and provide reasonable assurance that the structural integrity of the repaired pressure instrument nozzle will be maintained for remainder of the fourth ISI interval. The NRC staff further concludes that the proposed alternative for the repair of the subject pressure instrument nozzle provides an acceptable level of quality and

safety and that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC authorizes the use of RR 61 at PVNGS, Unit 3 until the end of the fourth ISI interval, which is currently scheduled to end on January 10, 2028.

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

Principal Contributors: B. Fu
S. Cumblidge

Date: February 19, 2019

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNIT 3 – RELIEF REQUESTS 60 AND 61 FOR THE FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL, REQUEST FOR RELIEF FROM THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS – HALF-NOZZLE REPAIRS (EPID L-2018-LLR-0111 AND EPID L-2018-LLR-0112) DATED FEBRUARY 19, 2019

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