



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

May 12, 2022

Mrs. Maria L. Lacal
Executive Vice President
and Chief Nuclear Officer
Arizona Public Service Company
P.O. Box 52034, Mail Station 7605
Phoenix, AZ 85072-2034

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION UNITS 1, 2, AND 3 –
RELIEF REQUEST 67 FOR AN ALTERNATE FREQUENCY TO
CONTAINMENT UNBONDED POST-TENSIONING SYSTEM INSERVICE
INSPECTION (EPID L-2021-LLR-0050)

Dear Mrs. Lacal:

By letter dated July 29, 2021, Arizona Public Service Company (the licensee) submitted a relief request for an alternate frequency to containment unbonded post-tensioning system inservice inspection (ISI) at Palo Verde Nuclear Generating Station (Palo Verde) Units 1, 2, and 3 in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), "Acceptable level of quality and safety."

Specifically, pursuant to 10 CFR 50.55a(z)(1), the licensee requested U.S. Nuclear Regulatory Commission (NRC) approval of Relief Request 67 from the 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," subsection IWL, "Requirements for Class CC [Concrete Containment] Concrete Components of Light-Water Cooled Plants," the periodic visual examination and physical testing of containment building are required in accordance with table IWL-2500-1 (L-A), "Examination Categories, Examination Category L-A, Concrete," as well as physical testing of unbonded post-tensioning systems in accordance with table IWL-2500-1 (L-B), "Examination Category L-B, Unbonded Post-Tensioning System," for Palo Verde regarding an alternate frequency to containment unbonded post-tensioning system ISI.

This relief request proposes to perform visual and physical examination of the Palo Verde Units 1 and 3 concrete containment post-tensioning systems in accordance with the schedules identified in tables 2 and 4 of attachment 1 of the enclosure to the July 29, 2021, submittal. For Palo Verde Unit 2, the NRC approved a delay in performing the Unit 2 test to February 8, 2022, and later to June 8, 2022, due to COVID-19. As a result, the potential for an alternative examination schedule for Palo Verde Unit 2 post-tensioning system examinations and tests will be evaluated after this data has been collected.

As set forth in the enclosed safety evaluation, the NRC staff determines that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed the regulatory requirements set forth in

10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the proposed alternative at Palo Verde Units 1 and 3 for the third IWL ISI interval for a one-time, 10-year deferral to 20-years and does not authorize other requested items proposed by the licensee, as stated in the summary section of this enclosure.

All other ASME Code section XI requirements for which the alternative was not specifically requested and authorized in this proposed alternative remain applicable, including a 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 by email to Siva.Lingam@nrc.gov.

Sincerely,

Jennifer L. Dixon-Herrity, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-528, STN 50-529,
and STN 50-530

Enclosure:
Safety Evaluation

cc: Listserv



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST 67

REQUEST FOR AN ALTERNATE FREQUENCY TO CONTAINMENT UNBONDED

POST-TENSIONING SYSTEM INSERVICE INSPECTION

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3

DOCKET NOS. STN 50-528, STN 50-529, AND STN-530

1.0 INTRODUCTION

By letter dated July 29, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21210A300), Arizona Public Service Company (the licensee), requested authorization of a proposed alternative request from the 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," subsection IWL, "Requirements for Class CC [Concrete Containment] Concrete Components of Light-Water Cooled Plants," the periodic visual examination and physical testing of containment building are required in accordance with table IWL-2500-1 (L-A), "Examination Categories, Examination Category L-A, Concrete," as well as physical testing of unbonded post-tensioning systems in accordance with table IWL-2500-1 (L-B), "Examination Category L-B, Unbonded Post-Tensioning System," for Palo Verde Nuclear Generating Station (Palo Verde), Units 1, 2 and 3.

The licensee proposed to extend the post-tensioning system examination and testing interval from 10 years to 20 years for Palo Verde Units 1 and 3. For Palo Verde Unit 2, the U.S. Nuclear Regulatory Commission (NRC) approved a delay on April 2, 2021, in performing the Unit 2 test for 1 year due to COVID-19 in Relief Request 66 (ML21089A010). The due date was extended from February 8, 2021, to February 8, 2022. On February 23, 2022, this due date was further extended to June 8, 2022, due to COVID-19 (ML22049A057). As a result, the potential for an alternative examination schedule for the Palo Verde Unit 2 post-tensioning system examinations and tests will be evaluated after these data are collected. The licensee also proposed to permanently eliminate the requirements from paragraph IWL-2523, "Tendon Wire and Strand Sample Examination and Testing," subparagraph IWL 2523.2(b), "Sample Examination and Testing," to perform tension testing to determine the yield strength, ultimate tensile strength, and elongation of tendon wires. The licensee further proposed to limit the scope of tendons required to be detensioned in the subparagraph IWL-2523.1, "Tendon Detensioning and Sample Removal" requirement for sample tendons.

Enclosure

The licensee stated that “[p]ost-tensioning system examinations and tests performed to date have indicated that the post-tensioning systems are expected to maintain their safety-related function through the period of extended operation for [Palo Verde], Units 1, 2, and 3.”

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), “Acceptable level of quality and safety,” the licensee requested to use the proposed alternative to the examination requirements of the ASME Code, section XI, subsection IWL related to the containment unbonded post-tensioning system on the basis that the alternative provides an acceptable level of quality and safety. The proposed alternatives are requested for the third and subsequent fourth inservice inspection (ISI) intervals.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), “Inservice inspection standards requirement for operating plants,” throughout the service life of a nuclear power facility, components that are classified as ASME Class CC pressure retaining components must meet the requirements set forth in ASME Code, subsection IWL, as incorporated by reference in 10 CFR 50.55a(a)(1)(ii), “ASME Boiler and Pressure Vessel Code, Section XI,” subject to the conditions listed in 10 CFR 50.55a(b)(2)(ix), “Section XI condition: Metal containment examinations.” Section XI, subsection IWL of the ASME Code, provides rules for ISI and repair/replacement activities of the reinforced concrete and post-tensioning system components of class CC containment structures. Alternatives to the requirements of 10 CFR 50.55a(g), “Preservice and inservice inspection requirements,” may be authorized by the NRC under 10 CFR 50.55a(z)(1) if the licensee demonstrates that the proposed alternative would provide an acceptable level of quality and safety.

The licensee’s relief request proposes the alternatives from the ASME Code’s requirements as follows:

1. Extend the post-tensioning system examination and testing interval from 10 years to 20 years for Palo Verde, Units 1 and 3.
2. In lieu of the subparagraph IWL-2523.1 requirement, which states that “[o]ne sample tendon of each type shall be completely detensioned,” and that “[a] single wire or strand shall be removed from each detensioned tendon,” the licensee proposes to detension a tendon and remove a single wire for examination only if a tendon anchorage visual examination in accordance with paragraph IWL-2524, “Examination of Tendon Anchorage Areas,” detects a number of ineffective wires (i.e., broken/protruding wires or missing buttonheads) in excess of that permitted by the design or if required as a result of an engineering evaluation performed in accordance with subarticle IWL-3300, “Evaluation.”
3. In lieu of the subparagraph IWL-2523.2(b) requirement to perform tension testing to determine the yield strength, ultimate tensile strength, and elongation of tendon wires, the licensee proposes to eliminate these test requirements for Palo Verde Units 1, 2, and 3.
4. The proposed alternatives are requested for the third and subsequent fourth ISI intervals.

The licensee used the fact that post-tensioning system examinations and tests performed to date have indicated that the post-tensioning systems are expected to maintain their safety-related function through the period of extended operation for Palo Verde, Units 1, 2, and 3, as a reason for the requested relief request.

The licensee requested authorization for use of the proposed alternative for the third and fourth ISI intervals pursuant to 10 CFR 50.55a(z)(1) on the basis that it provides an acceptable level of quality and safety, based on performance of its post-tensioning system components as supported by documented data of past plant-specific examinations, and testing and operating experience.

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 Licensee's Proposed Alternative

The licensee proposed the Alternative Relief Request (RR)-67 for Palo Verde Units 1, 2 and 3 unbonded post tensioning system ISI requirements. Specifically, the request is against the following examination requirements in table IWL-2500-1 (L-B) of the ASME Code, section XI, subsection IWL.

- Item number L2.10 requires that selected tendon force and elongation be measured every 5 years (10 years for two units or more meeting subparagraph IWL-2421(b) alternative scheduling requirements) in accordance with paragraph IWL-2522, "Tendon Force and Elongation Measurements."
- Item number L2.20 requires that tendon single wire samples be removed and examined for corrosion examinations and mechanical damage as well as tested to obtain yield strength, ultimate tensile strength, and elongation on each removed wire. This inspection must be done every 5 years (10 years for two units or more meeting subparagraph IWL-2421(b) alternative scheduling requirements) in accordance with paragraph IWL-2523.
- Item number L2.30 requires that a detailed visual examination on selected tendon anchorage hardware and adjacent concrete extending 2 feet from the edge of the bearing plate be performed every 5 years (10 years for two units or more meeting subparagraph IWL-2421(b) alternative scheduling requirements) in accordance with paragraph IWL-2524. In addition, the quantity of free water released from the anchorage end cap, as well as any free water that drains from the tendon during examination, must be documented.
- Item number L2.40 requires that samples of selected tendon corrosion protection medium (CPM) be obtained and analyzed every 5 years (10 years for two units or more meeting subparagraph IWL-2421(b) alternative scheduling requirements) in accordance with paragraph IWL-2525, "Examination of Corrosion Protection Medium and Free Water."

- Item number L2.50 requires that samples of free water be obtained and analyzed every 5 years (10 years for two units or more meeting subparagraph IWL-2421(b) alternative scheduling requirements) in accordance with paragraph IWL-2525.

The licensee's proposed alternatives, corresponding to the above code requirements, are requested for the current third and subsequent fourth ISI intervals for Palo Verde Units 1, 2 and 3, as stated below:

- For item numbers L2.10, L2.30, L2.40, and L2.50, the proposed alternatives are to extend the interval of the examination from 10 to 20 years.
- For item number L2.20, in addition to extending the interval of the examination from 10 to 20 years, the proposed alternatives are stated in items 2 and 3 in section 2.0 of this safety evaluation (SE).

To demonstrate that the proposed alternative actions will provide an acceptable level of quality and safety, the licensee provided the information summarized below. The licensee also provided additional benefits to the deferral of the physical testing, such as less exposure of personnel to industrial safety hazards and a reduction of unnecessary loading cycles on the tendons and environmental waste.

The licensee stated that ASME section XI, subsection IWL requires periodic visual examination of concrete containment building and physical testing of post-tensioning systems. The examination and testing to date have indicated that the post-tensioning system is expected to maintain its safety-related function through the period of extended operation for Palo Verde Units 1, 2, and 3. In its request, the licensee noted that the proposed alternatives only apply to the tendon tests and associated examinations that require close, in access to tendon end anchorage areas. General visual or detailed visual examinations of accessible containment concrete surfaces, bearing plates, and tendon end caps will continue to be performed at the required 5-year interval in accordance with table IWL-2500-1 (L-A), subsubarticle IWL-2410, "Concrete," and subsubarticle IWL-2510, "Surface Examination." If these visual examinations reveal conditions that could indicate degradation of tendons or tendon hardware components, additional examinations per item numbers L2.10, L2.20, L2.30, L2.40 or L2.50 may be conducted, as determined and documented by the responsible engineer.

The licensee's request provides plant specific examination results on Palo Verde Units 1, 2, and 3, as a basis for the proposed deviations from the ASME section XI requirements.

3.2 NRC Staff Evaluation

The NRC staff reviewed the information provided in the proposed alternative request and noted that the licensee will continue to conduct the general visual examinations, and detailed visual examination of suspect areas, on a 5-year frequency as required by table IWL-2500-1 (L-A). Any indications identified during these examinations may lead to additional examinations in accordance with table IWL-2500-1 (L-B), as determined by the responsible engineer. As required by paragraph IWL-2511, "Accessible Areas," this would include examination of the concrete surfaces and tendon end anchorage areas (end caps, bearing plates, concrete in the area) on a 5-year frequency to identify evidence of damage, deformation, water intrusion, corrosion, cracking or CPM leakage. Tendon end caps are required to be removed for this examination if there is evidence of tendon end cap deformation or damage. The NRC staff also reviewed the plant-specific information, and summary results of examinations conducted for

each of the requirements of ASME section XI, subsection IWL, table IWL-2500-1 (L-B), item numbers L2.10, L2.20, L2.30, L2.40, and L2.50. A summary of the NRC staff's evaluation of each item number is provided below.

Item Number L2.10, Tendon Force Trends and Forecasts

The licensee stated in its submittal that:

One tendon ([Palo Verde] Unit 3 H21-005) has detected a lift-off force lower than the predicted lower limit for its tendon group. The measured force in this tendon was 98.6 [percent] of the predicted lower limit. Lift-off forces were measured in the adjacent tendons, and these measurements, along with those in tendon H21-005, met the applicable acceptance standards. Tendon H21-005 was then retensioned to an acceptable force.

The data shows that tendon force measurements have remained above the MRV [minimum required value], and that the predicted average tendon forces for each type of tendon will remain above the required minimum design prestress force well beyond the end of the plant life.

The NRC staff reviewed the lift-off force data in provided by the licensee in their July 21, 2021 request and verified that the projected forces remain above the MRV through the next inspection and through the end of the current operating license. Based on the statistical analyses of past surveillance results, and the significant margin between the measured force trend (forecast) values and the MRV, the NRC staff finds it acceptable to extend the interval of the post tensioning system examinations and tests (ASME section XI, table IWL 2500-1 (L-B), item number L2.10) from 10 years to 20 years for the third 10 year Palo Verde Units 1 and 3 IWL ISI interval. The applicant also requested to extend the fourth interval of the post-tensioning system examinations and tests from 10 years to 20 years for Palo Verde Units 1 and 3 IWL ISI interval. The NRC staff evaluation of the fourth interval is discussed below in the summary section of this SE

Item Number L2.20, Wire Examination and Test Results

The licensee stated that (1) results of tension tests on all wires removed from tendons in Palo Verde Units 1, 2, and 3 have met material specification requirements for ultimate tensile strength (240 kilos per square inch) and elongation (4 percent at failure), and (2) visual examination of all wires removed from tendons in Palo Verde Units 1, 2, and 3 since initial tendon installation have shown no signs of corrosion or physical damage, demonstrating that the post-tensioning system CPM has continued to protect tendon wires from corrosion.

The above statements meet the ASME Code's requirement. The NRC staff finds it acceptable to waive the requirement for sample wire removal and testing (ASME section XI, table IWL-2500-1 (L-B), item number L2.20) for the third 10-year IWL ISI Interval. The applicant also requested the requirement for sample wire removal and testing for the fourth IWL ISI Interval be waived. The NRC staff evaluation of the fourth interval is discussed below in the summary section of this SE.

Item Number L2.30, Anchorage Hardware and Surrounding Concrete Inspection

The licensee stated that (1) the results of visual examinations of tendon anchorage hardware (anchorheads, shims, and buttonheads) and bearing plates have demonstrated that the condition of anchorage components remains acceptable, and (2) tendon anchorage concrete examinations have been performed on anchorage areas of hoop tendons. Cracking of concrete adjacent to bearing plates has been observed, and crack mapping has been documented when such cracking has been detected. These conditions have been accepted by engineering.

The NRC staff reviewed the data presented by the licensee during the past surveillances. The data indicate that there is no active corrosion on anchor heads, bushings, shims, buttonheads or areas of bearing plates. Therefore, the NRC staff finds it acceptable to extend the interval of the anchorage hardware examinations (ASME section XI, table IWL-2500-1 (L-B), item number L2.30) from 10 years to 20 years for the third 10-year IWL ISI Interval for Palo Verde Units 1 and 3. The applicant also requested to extend the interval of the anchorage hardware examinations from 10 years to 20 years for the fourth IWL ISI Interval for Palo Verde Units 1 and 3. The NRC staff evaluation of the fourth interval is discussed below in the summary section of this SE.

Item Numbers L2.40 and L2.50, CPM and Free Water Testing

The licensee stated that results of tendon CPM tests at Palo Verde Units 1, 2, and 3 have met acceptance standards during all examinations, except that the results of CPM testing for several surveillances early in the plant life were not located, and free water has not been detected during surveillances of vertical and hoop tendons at Palo Verde Units 1, 2, and 3.

Based on a review of the past inspection results, the NRC staff finds it acceptable to extend the interval of the CPM test for absorbed water, and free water tests (ASME section XI, table IWL-2500-1 (L-B), item numbers L2.40 and L2.50) from 10 years to 20 years for the third 10-year IWL ISI interval for Palo Verde Units 1 and 3. The applicant also requested to extend the interval of the CPM test for absorbed water, and free water tests from 10 years to 20 years for the fourth IWL ISI interval for Palo Verde Units 1 and 3. The NRC staff evaluation of the fourth interval is discussed below in the summary section of this SE.

Summary

Based on the above evaluation, the NRC staff determines that the licensee has demonstrated adequate performance of the unbonded post-tensioning system by presenting plant-specific post-tensioning system inspection results and operating experience, and technical evaluations demonstrating applied tendon prestress will remain acceptable through the extended inspection intervals. Therefore, the NRC staff finds that the use of proposed Alternative RR-67 for the third IWL ISI interval provides an acceptable level of quality and safety.

The NRC staff approves the alternative proposal to extend the interval of the post-tensioning system tendon lift-off force examinations for a "one-time" 10 years deferral to 20 years (table IWL-2500-1 (L-B), item number L2.10), and to waive (1) the sample wire removal and testing for a "one-time" 10 years deferral (table IWL-2500-1 (L-B), item number L2.20) to 20 years, (2) the requirement of tendon anchorage end cap removal and the recording of the quantity of free water released from the end cap and the tendon during examination for a "one-time" 10 years deferral (table IWL-2500-1 (L-B), item number L2.30) to 20 years, and (3) the test of CPM for corrosive ions and neutralization number for a "one-time" 10 years deferral

(table IWL-2500-1 (L-B), item numbers L2.40 and L2.50) to 20 years, for the third IWL ISI Interval.

The NRC staff finds it reasonable to approve a one-time interval extension, based on its review of the plant-specific testing results and operating experience provided in the relief request. However, the NRC staff does not find it reasonable to extend the inspection intervals for the fourth ISI interval, without reviewing the results of the third IWL ISI inspection results and the results of the general visual examinations, and detailed visual examination of suspect areas, conducted prior to the initiation of the fourth ISI interval. Therefore, the NRC staff does not approve the licensee's request for the proposed alternatives to be applicable to the fourth ISI interval.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the proposed alternative at Palo Verde Units 1 and 3 for the third IWL ISI interval for a one-time 10-year deferral to 20 years and does not authorize other requested items proposed by the licensee, as stated in the summary section above.

All other ASME Code section XI requirements for which the alternative was not specifically requested and authorized in this proposed alternative remain applicable, including a third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: J. Ma, NRR

Date: May 12, 2022

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3 –
RELIEF REQUEST 67 FOR AN ALTERNATE FREQUENCY TO
CONTAINMENT UNBONDED POST-TENSIONING SYSTEM INSERVICE
INSPECTION (EPID L-2021-LLR-0050) DATED MAY 12, 2022

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