



## Technical Specification 5.6.8

102-08414-KJG/MSC  
March 31, 2022

**Palo Verde  
Nuclear Generating Station**  
P.O. Box 52034  
Phoenix, AZ 85072  
Mail Station 7605  
Tel 623 393 2488

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

Subject: **Palo Verde Nuclear Generating Station Unit 3  
Docket No. 50-530  
Renewed Operating License Number NPF-74  
Response to NRC Requests for Additional Information  
Regarding 2021 Unit 3 Steam Generator Tube Inspections**

By letter dated October 19, 2021 [Agencywide Documents Access and Management System (ADAMS) Accession No. ML21292A184], Arizona Public Service Company (APS) submitted information summarizing the results of the Spring 2021 steam generator tube inspections at Palo Verde Generating Station (PVNGS) Unit 3.

The Nuclear Regulatory Commission (NRC) staff reviewed the information provided by APS and determined that additional information was needed to complete its review of the steam generator tube inspections. A clarifying call was held between the NRC staff and APS on February 23, 2022, to discuss the additional information needed. The APS response to the final NRC staff requests for additional information [ADAMS Accession No. ML22055A584] dated February 24, 2022, is provided in the enclosure to this letter.

No commitments are being made to the NRC by this letter. Should you need further information regarding this response, please contact Matthew S. Cox, Licensing Section Leader, at (623) 393-5753.

Sincerely,

Digitally signed by Gil, Katherine  
J(Z05492)

Date: 2022.03.31 06:50:26 -07'00'

Katherine J. Gil  
Director, Nuclear Regulatory Affairs

KJG/MSC/mg

Enclosure: Response to Requests for Additional Information for Steam Generator Tube Inspections in Unit 3

cc: S. A. Morris NRC Region IV Regional Administrator  
S. P. Lingam NRC NRR Project Manager for PVNGS  
L. N. Merker NRC Senior Resident Inspector for PVNGS

**ENCLOSURE**

**Response to Requests for Additional Information for  
Steam Generator Tube Inspections in Unit 3**

**Enclosure**  
**Response to Requests for Additional Information**  
**for Steam Generator Tube Inspections in Unit 3**

**Introduction**

By letter number 102-08346, dated October 19, 2021 [Agencywide Documents Accession No. ML21292A184], Arizona Public Service Company (APS) submitted information summarizing the results of the Spring 2021 steam generator (SG) tube inspections at the Palo Verde Nuclear Generating Station (PVNGS) Unit 3.

The Nuclear Regulatory Commission (NRC) staff reviewed the information provided by APS and determined that additional information was needed to complete its review of the SG tube inspections. A clarification call was held on February 23, 2022. The APS response to the final NRC staff requests for additional information [ADAMS Accession No. ML22055A584] dated February 24, 2022, is provided in this enclosure. The NRC request is provided first followed by the APS response.

**NRC Request 1**

*The SG tube in Row 42, Column 89 (R42C89) in SG 31 was reported to have a 57 percent through wall (TW) wear indication associated with batwing 1. The NRC staff noted that this wear indication was reported as 18 percent TW during 3R20 (spring 2018, ADAMS Accession No. ML18306A999). Section 8.0, "Condition Monitoring," of the spring 2021 SG tube inspection report states that no structural and/or leakage integrity threshold values were exceeded, all SG performance criteria were satisfied during Cycles 21 and 22, and no in-situ pressure testing was required. Tube R42C89 in SG 31 was plugged during 3R22. Please discuss the following relative to the 57 percent TW wear indication associated with batwing 1 in tube R42C89 in SG 31:*

- a. *Was this wear indication within the previous operational assessment predictions? If not, what changes have been made to the operational assessment?*
- b. *Provide the structural length and depth of the wear scar as compared to a wear scar at the condition monitoring limit.*
- c. *Any available insights (e.g., thermal hydraulic conditions) on what contributed to the large growth between 3R20 to 3R22.*

**APS Response**

- 1a. Yes, the worst observed wear indication was predicted and bounded by the previous operational assessment (OA). Therefore, no changes were made to the OA.

The wear indication on tube R42C89 in SG31 was measured at 57 percent through-wall (TW) maximum NDE depth with a bobbin probe at a Diagonal Support (Batwing) location during the Unit 3 Refueling Outage 22 (3R22). The flaw was subsequently line-by-line profiled with a +Point™ probe and determined to have a mean structural depth, including measurement uncertainty, of 53.6 percent TW. The Unit 3 Refueling Outage 20 (3R20) OA predicted an actual mean value for the structural depth of the worst-case flaw at a Batwing location of 55.3 percent TW for 3R22 as described in the Mean Maximum Structural Depth from Figure 4.3-2 of the 3R20 OA. The OA predicted mean structural depth of 55.3 percent TW exceeds the mean structural depth of the detected flaw in R42C89 of 53.6 percent TW.

**Enclosure**

**Response to Requests for Additional Information  
for Steam Generator Tube Inspections in Unit 3**

Therefore, the 3R20 OA model prediction, determined in 2018, bounded the detected indication in Tube R42C89 in SG31 at the 3R22 outage inspection.

- 1b. The SG performance criteria were satisfied during Cycles 21 and 22 for the flaw discovered on tube R42C89 in SG31. No in-situ pressure testing was, therefore, required. The evaluation is documented in the U3R22 Condition Monitoring Evaluation.

A line-by-line profiling of the flaw on tube R42C89 was performed utilizing plus point data. This profile accurately depicts the dimensions of the wear indication. Using the Structural Minimum Method, the lower 95-50 burst pressure was conservatively calculated as 4080 psi, which contains a significant margin above the actual three times Normal Operating Differential Pressure (3xNODP) of 3750 psi. When analyzed for the actual 3xNODP pressure of 3750 psi, the wear indication on tube R42C89 in SG31 meets the Structural Integrity Performance Criterion (SIPC) margin requirement.

To address the structural depth and structural length of a postulated flaw at the condition monitoring (CM) limit of 3xNOPD, the profile analysis was re-evaluated by adjusting the depth of the subject flaw geometrically until a 95-50 burst pressure of 3750 psi was achieved. The measured length of the flaw was kept constant since the length would be limited by the width of the Batwing support. This re-analysis resulted in a wear flaw with a structural depth of approximately 67 percent TW and a structural length of approximately 0.503 inch. This exceeds the actual mean structural depth of the flaw in R42C89 of 53.6 percent TW. The postulated flaw, therefore, conservatively meets the CM limit for 3xNOPD.

- 1c. The wear flaw observed on tube R42C89 in SG31 during 3R22 was caused by a phenomenon called Central Cavity Wear Region (CCWR) wear. Due to the stay cylinder design of the PVNGS SGs, a central cavity exists in the SGs which is absent of tubes. During operation, the fluid flowing up through this cavity has a relatively high velocity. The CCWR wear results from tube vibration that is caused by the high energy fluid flowing past the horizontal tube span in the central cavity region of the SG. The wear is located in the upper portion of the tube bundle at the diagonal supports (batwings). The wear is most pronounced in the first 3 "rings" of tubes that are adjacent to the central cavity. Tubes more than a few rings into the bundle are supported by an additional vertical support and, therefore, have lower wear rates than the tubes in the first 3 rings. In Unit 3, each of the ring 1 tubes were plugged at the factory. The majority of ring 2 tubes are also plugged at this time. Tube R42C89 was a ring 2 tube.

CCWR wear has existed since the installation of the Replacement Steam Generators in 2003. The CCWR wear is being successfully managed using the SG Inspection/Operational Assessment process.

**Enclosure**

**Response to Requests for Additional Information  
for Steam Generator Tube Inspections in Unit 3**

**NRC Request 2**

*Table 2, "Indication Summary," in Section 8.0 of the spring 2021 SG tube inspection report states that two tubes and seven tubes were plugged in SGs 31 and 32, respectively, due to "Preventative Level III Discretion Due to Array." Please provide additional detail on why these nine tubes were plugged (e.g., insights from the raw array data).*

**APS Response**

Each of the additional tubes that were plugged due to Level III discretion had wear indications that were close to the plugging limit with bobbin probes but over the plugging limit with array probes. These wear indications sized larger with the array probe than the bobbin probe. PVNGS was looking into sizing anomalies with bobbin probes from outage to outage. It was determined that the measurement differences are applicable across all units, from outage to outage, and the measurement differences in 3R22 was not an outlier. It is normal for indications to measure slightly different when using a bobbin versus array or +Point™ probe.

The bobbin probe depth sizing is used for SG tube integrity assessments and plugging decisions. The level III decided to plug conservatively, while further investigating bobbin sizing variances. There was nothing new or concerning about the wear indications and these tubes were plugged based on indicated size only.