APS A subsidiary of Pinnacle West Capital Corporation

Palo Verde Nuclear Generating Station

Dwight C. Mims
Vice President
Regulatory Affairs and Plant Improvement

Tel. 623-393-5403
Fax 623-393-6077

Mail Station 7605
P. O. Box 52034
Phoenix, Arizona 85072-2034

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

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Unit 1, Docket No. STN 50-528
Response to Request for Additional Information - Steam Generator Tube Inspection Report

By letter dated August 4, 2008, the Nuclear Regulatory Commission (NRC) requested additional information pertaining to the Unit 1 steam generator tube inspection report, dated January 2, 2008 (Agencywide Documents Access and Management System Accession No. ML080090193). The requested information is to be submitted within 60 days of the request. The APS response to the requested information is enclosed.

APS makes no commitments in this letter. If you have questions regarding this submittal, please contact Russell A. Stroud, Section Leader, Regulatory Affairs, at (623) 393-5111.

Sincerely,

Scott Bauer for DCM

DCM/RAS/RJR/gat

Enclosure

cc: E. E. Collins Jr. NRC Region IV Regional Administrator
B. K. Singal NRC NRR Project Manager
R. I. Treadway NRC Senior Resident Inspector

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NRR

ENCLOSURE

Response to Request for Additional Information
Unit 1- Steam Generator Tube Inspection Report

NRC Question 1

Please indicate whether the Unit 1 SG design is the same as the Unit 2 SG design. If the Unit 1 SG design is different, please discuss any differences in the design (e.g., number of tubes, nominal tube diameter and wall thickness, tube spacing, etc.)

APS Response

The replacement steam generators (RSGs) in PVNGS Units 1, 2 and 3 have essentially the same design. The RSGs were designed by Asea Brown Boveri/Combustion Engineering (ABB/CE) (now Westinghouse) and manufactured by Ansaldo, and are considered a modified System 80 design (no specific model number). Each of the RSGs contains 12,580 tubes which are constructed from thermally treated Alloy 690. Each tube is ¾ inch outside diameter and has a nominal wall thickness of 0.042 inch and an average heated length of 63.9 feet resulting in a total of 157,838 ft^2 of heat transfer area. The RSG tubing in the PVNGS RSGs was manufactured by Sandvik to the requirements of ASME SB-163 (Alloy 690).

NRC Question 2

The Unit 2 SGs had several tubes affected by wear in the Stay Cylinder region, yet this inspection report indicates that very little wear was observed on tubing in either SG 11 or SG 12. Please discuss any insights regarding potential differences in performance.

APS Response

When compared to the first RSG inspection conducted during the Unit 2 refueling outage 12 (U2R12), the amount of SG tube wear found during the first RSG inspection conducted in Unit 1 during refueling outage 13 (U1R13) was very low. Wear was found on only two tubes in each RSG, with the deepest wear scar measuring only 13% through wall (TW). Although it is still too early in the life of the SGs to draw firm conclusions, the following factors may explain this difference:

1. The front row of the Central Cavity Wear (CCW) Region (formerly called the Batwing Stay Cylinder (BWSC) region) was plugged and staked prior to the installation of the Unit 1 RSGs (see response to question 3 below). Historically, the largest wear rates in the CCW region have been found in these frontline tubes. As these tubes were plugged in the Unit 1 RSGs, non-destructive examination (NDE) data are not available to confirm the presence of wear in this region.

2. The length of the operating cycle (C13) which preceded the first inspection in the Unit 1 RSGs was relatively short due to an extended shutdown to repair the shutdown cooling line vibration. In order for wear to be initiated in RSG tubes, an appreciable feedwater flow must exist (greater than 80%). When compared to a normal cycle, C13 was only at greater than 80% feedwater flow for about 65% of a normal cycle.

NRC Question 3

The plugging history indicates that over 50 tubes were plugged in each SG during the baseline inspection in 2005. Please summarize the reasons for plugging these tubes.

APS Response

U2R12 represented the first inservice inspection of the Unit 2 RSGs. The eddy current (ECT) inspections revealed unexpected wear, with respect to extent and severity, in a region previously referred to as the BWSC region in the original System 80 steam generators. The detected U2R12 tube wear resulted in a classification of "active damage mechanism" per the Electric Power Research Institute (EPRI) *PWR Steam Generator Examination Guidelines*, and as such, required an inspection periodicity of every refueling outage in Unit 2. The largest wear indication found in U2R12 was 40% and, as such, the condition did not represent a structural or integrity issue.

Following this discovery in U2R12, APS Engineering decided to review the benefits of a pre-service preventative plugging program in the Unit 1 RSGs. Traditionally, the frontline tubes in the BWSC region had the highest risk of developing high wear rates. The PVNGS Administrative Plugging and Staking Guidelines required the first tube in a column exhibiting wear > 20% in the BWSC region be plugged and staked. Since these plugging and staking activities involve high cost, outage schedule impacts, and extra dose, Engineering recommended the preventative plugging and staking of the frontline tubes in the Unit 1 RSGs. At the time, Westinghouse did not believe that the current data indicated that plugging and stabilizing was necessary for these tubes since tube integrity limits did not appear to be challenged over one cycle of operation. However, given that there was only one data point available to assess this condition and that plugging / stabilizing in the Unit 1 RSGs could be performed off critical path and with no dose, APS determined that it was a reasonable decision. Westinghouse suggested that if APS desired to perform preventive plugging and stabilizing in the first row around the stay cylinder, that it be performed between columns 82 and 122 (total of 36 tubes). For reasons of conservatism, APS decided to plug and stake the frontline tubes between columns 75 and 129. The staking and plugging scope included 54 tubes in SG11 and 54 tubes in SG12.

NRC Question 4

In addition, please discuss the scope and results of any inspections performed in the Unit 1 SGs (during the baseline or first inservice inspection) to address the postulated "packaging screw damage" of the Unit 2 SGs.

APS Response

Corrective action program Condition Reporting Disposition Request (CRDR) 2685303 was generated as a result of the Unit 2 tube leak that occurred on 2/19/04. In response, a corrective action was initiated to evaluate tube locations where packaging damage was possible (as defined by the SG fabricator) and incorporate NDE inspections as deemed necessary in the SG management program. Based on the results of a study indicating that small dents (less than 1 volt) from packing crate screws may contain flaws, it was determined that all dents not previously inspected would be inspected during U2R12. In addition, inspection personnel were trained and tested using the data from the U2 tube leak.

Based upon the U2 experience, the Unit 1 RSG Preservice Inspection Plan was developed as follows:

Scope:	Dents (DNT) RC
Inspection Method:	(Plus Point)
Extent:	Various
RSG 11:	~1000 (estimate based on Unit 2 RSGs)
RSG 12:	~1000 (estimate based on Unit 2 RSGs)
Comment:	100% inspection of the DNT indications as apposed to a sample

The dent criterion threshold was a reading above 0.5 volts. This was the same voltage criteria utilized for the examinations during U2R12 (after the screw damage leak) to validate there were no other similar indications. As a result of the preservice inspection of the Unit 1 RSGs, 784 tubes were inspected with a rotating coil probe in SG11 and 556 tubes were inspected with a rotating coil probe in SG12 for indications similar to the dent that leaked. The inspection resulted in no tubes being plugged. During the first inservice inspection a rotary coil probe was again used to examine the largest voltage dent indications identified during the pre-service inspection. Analysts were trained on the U2 leak scenario, and no changes or abnormalities in these indications were identified.

NRC Question 5

Please discuss the scope and results of any secondary side inspections, other than the foreign object search and retrieval inspections already addressed in this inspection report.

APS Response

During the U1R12 preservice inspection, eddy current inspections were conducted while the replacement steam generators were in a horizontal position. As such, additional concerns regarding the possible migration of parts during and after the steam generators were transported, uprighted and installed needed to be addressed. Based on the preservice examination, APS Engineering developed an action plan to address the potential loose parts (PLP) locations identified by the eddy current findings. The actions taken are summarized below.

RSG 11

The approach to address the PLP readings that were detected during the preservice inspection of RSG 11 was to first attempt visual confirmation of the foreign objects and removal, if possible. If foreign object search and retrieval (FOSAR) was not successful, a technical evaluation regarding the wear potential at the identified locations and possible migration paths would be conducted. Visual inspections conducted by APS Engineering and the FOSAR vendor were successful in locating the parts. The parts were determined to be magnets used to secure a foreign material exclusion (FME) cover during RSG fabrication. Based on a review of the Ansaldo fabrication records, the RSG position, RSG design features, eddy current test (ECT) capability and a preliminary Westinghouse assessment that these parts could generate high wear rates down to the first full eggcrate support (08H/08C), APS could not exclude the potential and possible consequences of additional magnets in the steam generator. As such, APS and the FOSAR vendor conducted additional FOSAR after the RSGs were installed. The inspection scope included a full periphery inspection from the top of the bundle to the 08H/08C support. The inspection determined that the critical region was object free.

RSG 12

The PLPs identified in the pre-service eddy current testing were not in locations that could be accessed for visual inspection or retrieval. As such, APS Engineering worked with Westinghouse to perform a wear assessment. Based on the assessment results, Engineering determined that the exclusion zones identified in the Westinghouse analysis for high foreign object wear should be verified as free of foreign objects via visual or ECT examination after the steam generators were installed. These exclusion zones were specified as four rows in from the periphery at the cold leg flow distribution plate and eight rows in from the periphery at the hot leg tubesheet. After RSG installation, a Flow Distribution Plate (FDP) periphery inspection was performed. APS, with support from the FOSAR vendor was able to visually inspect a minimum of four tubes into the bundle at the FDP periphery. The RSG 12 inspection revealed minor debris consisting of grit, rust and fibers. One piece of plastic "bullet nose" was identified on the outer periphery of the tubes. Ansaldo nonconformance report (NCR) (APV- 02141-T, Ansaldo PV-NCR-32-UCN029) had previously evaluated the plastic bullet noses as being acceptable to remain in the Steam Generators. APS has reviewed and concurs with Ansaldo's disposition of the plastic "bullet nose" remaining in RSG 12.