



Palo Verde Nuclear
Generating Station

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U.S. Nuclear Regulatory Commission
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- References
1. NEI Letter, "Steam Generator Tubesheet Inspection Information," dated February 4, 2003, Alex Marion (NEI) to Richard Barrett (USNRC)
 2. Letter 102-04844-CDM/TNW/JAP, "Exigent Amendment Request to Technical Specification 5.5.9, Steam Generator (SG) Tube Surveillance Program," dated September 26, 2002, C. D. Mauldin, APS to USNRC
 3. Letter 102-04856 CDM/TNW/RJR, "Response to Request for Additional Information to Proposed Exigent Amendment to Technical Specification 5.5.9, Steam Generator Tube Surveillance Program," dated October 23, 2002, C. D. Mauldin, APS to USNRC
 4. Letter dated October 25, 2002, from the USNRC to APS, "Palo Verde Nuclear Generating Station, Unit 1 – Review Related to Steam Generator Tube Inspection (TAC NO. MB6378)"
 5. Letter 102-04865-CDM/TNW/RJR, "Request to Withdraw Proposed Exigent Amendment to Technical Specification 5.5.9, Steam Generator Tube Surveillance Program in accordance with 10CFR 2.107(a)," dated November 19, 2002, C. D. Mauldin, APS to USNRC
 6. Letter dated November 22, 2002, from the USNRC to APS, "Palo Verde Nuclear Generating Station, Unit 1 –Withdrawal of Amendment Request on the Steam Generator Tube Inspection (TAC NO. MB6378)"

**Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket Nos. STN 50-528/529/530
Steam Generator Tubesheet Inspection Information**

The NRC Staff requested that the Nuclear Energy Institute (NEI) coordinate the response to questions regarding the performance of steam generator (SG) inspections at 15 pressurized water reactors (PWRs) facilities that may be susceptible to stress corrosion cracking in tube sections contained within the steam generator tubesheet. Specifically, the NRC Staff requested information regarding:

1. The planned scope for the licensees next steam generator inspection,
2. The basis for the inspection program within the tubesheet area, and
3. A description of tubesheet inspection activities in the past.

In Reference 1, NEI indicated that affected licensees would provide the requested information by the end of March 2003. As an enclosure to this letter, Arizona Public Service (APS) has provided information in accordance with the NRC request using a format and template recommended by NEI.

With regard to tubesheet inspections, APS previously submitted References 2 and 3 above, requesting and providing additional information in support of an exigent amendment to the Unit 1 Technical Specification (TS) 5.5.9, Steam Generator (SG) Tube Surveillance Program.

On October 25, 2002, the NRC issued to APS Reference 4 concluding that the requested amendment was not needed prior to restart of Unit 1. Reference 4 states that the NRC Staff has no objection to an "inspection of the SG tubes under the current TSs prior to restart of Unit 1 from the current refueling outage," and that, "the proposed amendment is not needed on an exigent basis prior to restart of the plant."

Based on NRC Staff guidance contained in the October 25, 2002 letter and conversations with NRC Staff on this same subject, APS concluded that the proposed TS change was not needed to demonstrate operability of the SGs in Unit 1. Therefore, in accordance with 10 CFR § 2.107(a), APS requested to withdraw the proposed amendment request in Reference 5. Additionally, APS took the position that no TS change is required for Units 2 or 3 based upon the same rationale that no TS amendment is required for Unit 1. In Reference 6, the NRC concurred with APS's request with the understanding that APS would pursue future resolution of these issues on a generic basis. Compliance with the NEI information request is considered the next step in this process.

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No commitments are being made to the NRC by this letter.

Should you have any questions, please contact Thomas N. Weber at (623) 393-5764.

Sincerely,

A handwritten signature in black ink that reads "David Mauldin". The signature is written in a cursive style with a large, stylized initial "D".

CDM/TNW/JAP/kg

Enclosure

cc: E. W. Merschoff
J. N. Donohew
N. L. Salgado

ENCLOSURE

Palo Verde Nuclear Generating Station

Steam Generator Tubesheet Inspection Information

TUBESHEET INSPECTION PRACTICES

Plant Information

Plant Name: **Palo Verde Nuclear Generating Station, Unit 1**
T_{hot}: **612 °F**
Normal Steady State Full Power DP: **1270 psid**
Model of Steam Generator: **CE System 80**
Tube Material: **Alloy 600 MA**
Tube Diameter: **0.075 inch**
Tube Wall Thickness: **0.042 inch**
Expansion Process and Extent: **Explosive expansion (expansion)**
Tubesheet Thickness: **23.5 inches**

Susceptible to degradation below expansion transition region:

Yes No

Historical Inspection Practices and Results

See attached discussion and Table 1.

Planned Inspection for Next Outage

Anticipated date of outage – **4/3/2004 (U1R11)**
Techniques to be used: **Plus Point™**
Extent of inspections (be specific on landmarks used to determine inspection extent):
Seven (7) inches below bottom of expansion transition (BET).
Bases for inspection technique and inspection extent: **References 2, 3 and 4**

TUBESHEET INSPECTION PRACTICES

Plant Information

Plant Name: **Palo Verde Nuclear Generating Station, Unit 2**
T_{hot}: **614 °F**
Normal Steady State Full Power DP: **1270 psid**
Model of Steam Generator: **CE System 80**
Tube Material: **Alloy 600 MA**
Tube Diameter: **0.075 inch**
Tube Wall Thickness: **0.042 inch**
Expansion Process and Extent: **Explosive expansion (expansion)**
Tubesheet Thickness: **23.5 inches**

Susceptible to degradation below expansion transition region:

Yes No

Historical Inspection Practices and Results

See attached discussion and Table 1.

Planned Inspection for Next Outage

Anticipated date of outage – **9/27/2003 (U2R11)**

Techniques to be used: **None – In U2R11 the existing steam generators will be replaced.**

TUBESHEET INSPECTION PRACTICES

Plant Information

Plant Name: **Palo Verde Nuclear Generating Station, Unit 3**

T_{hot}: **612 °F**

Normal Steady State Full Power DP: **1270 psid**

Model of Steam Generator: **CE System 80**

Tube Material: **Alloy 600 MA**

Tube Diameter: **0.075 inch**

Tube Wall Thickness: **0.042 inch**

Expansion Process and Extent: **Explosive expansion (expansion)**

Tubesheet Thickness: **23.5 inches**

Susceptible to degradation below expansion transition region:

Yes No

Historical Inspection Practices and Results

See attached discussion and Table 1.

Planned Inspection for Next Outage

Anticipated date of outage – **3/29/2003 (U3R10)**

Techniques to be used: **Plus Point™**

Extent of inspections (be specific on landmarks used to determine inspection extent):

Nine (9) inches below bottom of expansion transition (BET).

Bases for inspection technique and inspection extent: **References 3, 4 and 6.**

Historical Information Summary

In Reference 4, Arizona Public Service Company (APS) provided a table (Table 7-1) that included outage, mean inspection extent Bottom of Data (BOD), the number of tubes with recordable Primary Water Stress Corrosion (PWSCC) circumferential cracks from TTS (Top of Tubesheet) of the hot leg to -7 inches (within the tubesheet), tubes with circumferential flaws at depth greater than seven inches only, and finally, the total number of circumferential flaws was provided to account for tubes with multiple sites. The listing does not include cracks found above the Bottom of the Expansion Transition (BET), as these are considered expansion transition defects and represent a different defect mechanism. The results from the recently completed U1R10 steam generator inspection were also included in the table. The Reference 4 table is reprinted as Table 1 of this attachment.

These results indicate that this defect mechanism (circumferential PWSCC) is not significant in Units 1 and 3. Additionally, a higher quantity of PWSCC defects is expected in Unit 2 based on operation at a higher T_{hot} (614° F vs. 612° F). As noted in the preceding plant information summary sheets, the steam generators in Unit 2 will be replaced in the fall of this year.

Table 1
PVNGS Circumferential Flaw Summary

Outage	Mean BOD		Tubes with Circ <7		Tubes with Circ >7 only		Total <7		Total >7	
	SG 1	SG 2	SG 1	SG 2	SG 1	SG 2	SG 1	SG 2	SG 1	SG 2
U1R7	NA	NA	0	0	0	0	0	0	0	0
U1R8	-3.57	-3.61	0	0	0	0	0	0	0	0
U1R9	-6.85	-7.1	0	2	1	1	0	3	1	3
U1R10	-8.89	-8.61	9	0	3	3	11	0	7	6
U2R7	NA	NA	0	6	0	0	0	7	0	0
U2R8	-3.51	-3.54	0	9	0	1	0	17	0	1
U2R9	-6.56	-7.08	1	66	0	0	1	104	0	32
U2R10	-6.73	-6.96	0	40	2	4	0	61	4	20
U3R6	NA	NA	0	2	0	0	0	2	0	0
U3R7	NA	NA	0	1	0	1	0	1	0	1
U3R8	-6.84	-6.83	0	4	0	0	0	8	0	1
U3R9	-6.81	-6.5	0	2	0	0	0	3	0	1

Notes: BOD – Bottom of Data, TTS – Top of Tubesheet (secondary face), BET – Bottom of Expansion Transition, NA – BOD data not recorded, inspection extent +/- 2 inches

Bases for Supplemental Inspection Extent

The basis for the use of Plus Point™ in supplementing tubesheet region exams was provided for Unit 1 in References 2, 3 and 4. The NRC indicated in Reference 5, that the program implemented at PVNGS Unit 1 for U1R10 yielded no restart issues.

For Palo Verde Nuclear Generating Station (PVNGS) Unit 2, the current steam generators are planned for replacement in U2R11. The U2R11 outage starts September 27, 2003. The replacement steam generators are an improved System 80 design and are fabricated with Alloy 690 TT (Thermally Treated) tubing. As indicated in APS Response to RAI Question 8 (Reference 4), the expected number of undetected flaws for the existing Unit 2 steam generators is on the order of 100-200 flaws. The upper bound leakage contribution from these flaws for the limiting design basis accident is projected to be less than 0.003 gallons per minute (gpm). This projected leakage is significantly less than the safety analysis allowance of 0.5 gpm per steam generator. As such, there are no structural or leakage integrity issues for Unit 2 Cycle 11.

For PVNGS Unit 3, APS has employed the same technical approach, as presented in References 2, 3, and 4 for Unit 1, for specifying a conservative inspection program for U3R10, scheduled to begin on March 29, 2003. The resulting inspection extent threshold is two (2) inches greater in Unit 3, than in Unit 1, for a total of nine (9) inches below the BET. As indicated in Reference 4, a gun drill process was used for drilling the PVNGS Unit 1 steam generator tubesheets. In the original Combustion Engineering Owners Group (CEOG) study (Reference 6), it was reported that Combustion Engineering changed their drilling process during fabrication of the PVNGS Unit 2 steam generators. The new process referred to as a Bore Trepanning Process (BTA) was adopted to increase productivity. The process had a consequential effect of producing smoother bore surfaces. For this reason, steam generators were either classified as rough bore or smooth bore in the CEOG study. Although CE was knowledgeable regarding the time frame the switch was made to BTA, fabrication records did not explicitly call out whether the tubesheet holes were gun drilled or drilled using BTA. Using the same methods for characterizing tube noise in Reference 4, APS has established that the Unit 3 steam generators have, in fact, a bore surface consistent with the BTA process. As such, the test data for Unit 1 is not applicable. Instead, the CEOG test program included "smooth bore" samples used to establish the required inspection threshold.

As indicated, APS has treated the smooth bore test data in a manner similar to Reference 4. The resulting inspection extent threshold has been found to be nine (9) inches below the bottom of the expansion transition. As indicated, this distance is two (2) inches farther than Unit 1 and four (4) inches farther than specified in the CEOG Study. For comparative purposes, the Summary Table (Table 12-1) provided in Reference 4 has been updated to indicate the assessment results for both Units 1 and 3, provided as Table 2. The inspection program for U3R10 has been updated to include this inspection extent for the supplementary Plus Point inspection program for 100% of the inservice tubes on the Hot Leg of both Unit 3 steam generators. A 20%

sample of the cold leg tubesheet region has been conducted previously and is planned for U3R10. No circumferential PWSCC has been detected in the cold leg tubesheet region of any of the PVNGS steam generators. If detected, the PVNGS inspection program requires expansion to 100% of all inservice tubing. Consequently, the inspection requirements of Technical Specification 5.5.9 are satisfied via a combination of defined sample programs, inspection techniques and specified extents. Additionally, APS is in compliance with the requirements of NEI 97-06 with respect to degradation assessment, inspection program requirements and determination that the structural and leakage integrity performance criteria are satisfied.

Table 2

Summary Table for PVNGS Units 1 and 3

	WCAP 15947-P	PVNGS Unit 1 (Rough Bore)	WCAP 15720 (Smooth Bore)	PVNGS Unit 3 (Smooth Bore)
Tube Engagement Area – Burst and Pullout	2.0"	3.0"	3.0"	3.3"
Tube Engagement Area – Leakage	2.0"	3.0"	3.0"	4.0"
Adjustment for Hole Dilation Effects – Pullout	1.75"	2.25"	1.75"	3.0"
Adjustment for Hole Dilation Effects – Leakage	1.75"	2.5"	1.75"	4.0"
Total Tube Engagement Area (TEA) (Pullout, Burst and Leakage)	3.75"	5.5"	4.75"	8.0"
Adjustment for Uncertainties (e.g., NDE, Test Variance) ¹	1.25"	1.5"	0.25"	1.0"
Total Inspection Extent	5"	7"	5"	9"

Note: Per Reference 4 the value for NDE uncertainty is given as 0.25 inches. The balance of uncertainty is considered margin for test variability.

References:

1. Letter 102-04844-CDM/TNW/JAP, Exigent Amendment Request to Technical Specification 5.5.9, Steam Generator (SG) Tube Surveillance Program, dated September 26, 2002

2. WCAP 15947-P, NDE Inspection Strategy for the Tubesheet Region in Palo Verde Unit 1, September 2002
3. APS Report, Supplemental Report to WCAP 15947-P for the Palo Verde Nuclear Generating Station, September 2002.
4. Letter 102-04856-CDM/TNW/JAP, Response to Request for Additional Information to Proposed Exigent Amendment Request to Technical Specification 5.5.9, Steam Generator Tube Surveillance Program, October 23, 2002.
5. NRC Letter, PVNGS Unit 1 Review Related to Steam Generator Tube Inspection, October 25, 2002.
6. WCAP 15720, NDE Inspection Strategy for Tubesheet Regions in CE Designed Units, CEOG Task 1154 Final Report, July 2001.
7. WCAP 14797, Generic W* Tube Plugging Criteria for 51 Series Steam Generator Tubesheet Region WEXTEx Expansions, February 1997.