December 28, 2005

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SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNIT 1 - REVIEW OF STEAM GENERATOR TUBE INSPECTION SUMMARY REPORT (TAC NO. MC7368)

Dear Mr. Levine:

The Nuclear Regulatory Commission (NRC) staff has completed its review of the reports submitted by Arizona Public Service (APS) summarizing the steam generator tube inspections performed during the fall 2002 and spring 2004 refueling outages at the Palo Verde Nuclear Generating Station (Palo Verde), Unit 1. These reports were provided in APS letters dated October 29, 2002, April 12, 2003, May 12, 2004, and April 18, 2005.

As discussed in the enclosed review, the NRC staff concludes that APS has provided the information required by the Palo Verde, Unit 1 technical specifications. In addition, the NRC staff did not identify any technical issues that warranted follow-up action at this time.

Sincerely,

/RA/

Mel B. Fields, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. STN 50-528

Enclosure: Review of Steam Generator Tube Inspections

cc: See next page

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REVIEW OF THE 2002 AND 2004 STEAM GENERATOR TUBE INSPECTION REPORTS

PALO VERDE NUCLEAR GENERATING STATION, UNIT 1

DOCKET NO. (STN) 50-528

By letters dated October 29, 2002 (ML023090325), April 12, 2003 (ML031080622), May 12, 2004 (ML041460209), and April 18, 2005 (ML051260348), Arizona Public Service (APS), the licensee, submitted information pertaining to the steam generator tube inspections performed during the fall 2002 and spring 2004 outages at the Palo Verde Nuclear Generating Station (Palo Verde), Unit 1.

Palo Verde, Unit 1 has two Combustion Engineering System 80 steam generators. There are 11,012 mill annealed Alloy 600 tubes in each steam generator. The tubes have an outside diameter of 3/4-inch, a wall thickness of 0.042-inch and are supported at various locations by ferritic stainless steel eggcrate supports, diagonal bars, and/or vertical straps.

The licensee provided the scope, extent, methods and results of their steam generator tube inspections in the documents referenced above. In addition, the licensee described corrective actions (i.e., tube plugging) taken in response to the inspection findings.

Based on a review of these documents, the Nuclear Regulatory Commission (NRC) staff prepared a request for additional information (RAI) which was forwarded to the licensee. The licensee responded to the staff's RAI. The staff's questions and the licensee's answers are attached to this evaluation. The licensee's responses were discussed during a phone call. During the discussion, the licensee clarified that the manufacturing burnish marks generally have not changed with time and that they believed the tube plugged during the 2004 inspections (1R11) was most likely plugged because the burnish marks could possibly mask the detection of a flaw. In addition, the licensee clarified that the volumetric flaws that initiated from the ID are typically grooves or some other manufacturing flaw rather than intergranular attack.

The 2004 inspections (1R11) were the last scheduled inspections of the Combustion Engineering System 80 steam generators at Palo Verde Unit 1 since the licensee replaced the steam generators in late 2005 (1R12).

Based on a review of the information provided, the staff concludes that the licensee provided the information required by their technical specifications. In addition, the staff concludes that there are no technical issues that warrant follow-up action at this time since the inspections appear to be consistent with the objective of detecting potential tube degradation and the inspection results appear to be consistent with industry operating experience at similarly designed and operated units.

Arizona Public Service (APS)
Response to the Staff's Request for Additional Information

NRC Staff Question1
Please clarify the scope of your rotating probe inspections of wear scars during your Unit 1 2004 (U1R11) inspections. The staff notes that your response to Generic Letter 2004-01 indicates that you perform rotating probe inspections of all previous wear calls and all new bobbin indications. However, Table 1 of your April 18, 2005, letter indicates far fewer rotating probe inspections of previous and current bobbin indications than the number of wear indications reported in Table 2. Is this a result of reporting the number of tubes in Table 1 and the number of indications in Table 2. Could this also be a result of some of the wear scars being examined as part of other examinations (e.g., rotating probe exams in the ARC)?

APS Response:
All bobbin wear indications, both new and previously called, are rotating pancake coil (RPC) examined. A significant number of wear indications are within the Palo Verde ARC location (See attached Tubesheet Maps for discussion purposes). These bobbin indications are, therefore, included in the ARC RPC examinations and not scheduled separately.

NRC Staff Question 2
Following your 2002 outage at Unit 2, you indicated that future inspections of dents/dings would include 100% of all dents greater than 2 volts between the top of the tubesheet and the fifth hot-leg tube support. At that time, the NRC staff made an observation that susceptibility to cracking depends not only on temperature but also on size of any dent or ding (e.g., a cold leg dent may be equally susceptible to cracking as a hot leg dent if the dent is larger on the cold leg). Please clarify the scope and results of your rotating probe examinations performed at dents/dings during your 2004 (U1R11) inspections. For any cracks detected at dented/dinged locations, please include the voltage magnitude of the dent/ding, the orientation of the indication (axial, circumferential), and whether the indication was also detected with the bobbin coil (during the normal routine analysis). The staff notes that dents/dings of a certain magnitude may result in the bobbin coil being ineffective to inspect at those locations. If all dents/dings above this threshold are not examined with a probe capable of finding the forms of degradation that could be occurring at these locations, please discuss your basis. Please discuss any sampling of dents/dings you perform at locations other than the hottest tube supports (assuming you do not perform 100% of all hot and cold dents/dings).

APS Response:
During U1R11, all dents over 2 volts from the top tubesheet hot leg thru the top horizontal support were RPC examined. In addition, any dent located in the regions of the nearly 10,000 non-tubesheet related RPC exams performed, was included in the Palo Verde dent assessment. This includes the hot or cold leg ARC regions, short radius U-Bend, or other special interest +Point examination areas. A total of 1778 dents were examined by RPC. There were no indications detected of primary stress corrosion cracking in any of these locations. Table 1 summarizes the number of dents by location.

Table 1
LOCATION vs NUMBER OF DENTS INSPECTED

Support	SG11	SG12
TSH	125	107
01H	23	33
02H	41	51

Support	SG11	SG12
03H	37	47
04H	42	23
05H	40	32
06H	96	65
07H	92	222
08H	26	87
09H	12	14
BW1	78	151
VS1	20	35
VS2	2	74
VS3	11	48
VS4	13	8
VS5	6	3
VS6	3	6
VS7	5	17
BW2	0	2
09C	1	2
08C	2	5
07C	7	8
06C	0	8
05C	0	0
04C	0	1
03C	0	0
02C	3	0
01C	1	0
TSC	12	31
Total	698	1080

NRC Staff Question 3
Regarding the volumetric indications detected during 2004 (U1R11) inspections and reported in Table 2 of your April 18, 2005, letter, please clarify whether any of the indications are a result of corrosion (i.e., volumetric indications other than manufacturing burnish marks, pit-like indications (nor corrosion related), tube-to-tube wear, or wear at tube supports). If any volumetric indications as a result of corrosion (e.g., intergranular attack) were left in service, please discuss your basis for leaving them in service. With respect to the volumetric indications that were plugged, please clarify the reason for plugging these indications. Specifically address whether any of the flaws previously attributed to manufacturing-related reasons (e.g., manufacturing burnish marks) have changed with time. If they have changed, please discuss why and whether this has led to any changes in how you classify indications (since the change may imply an active degradation mechanism at this location).

APS Response
As indicated in APS's response to Generic Letter 97-05 and per Palo Verde Administrative Plugging Criteria, any single volumetric indication/multiple volumetric indication (SVI/MVI) that indicates evidence of corrosion is removed from service regardless of size. When SVI/MVI indications are detected/called, a historical review is performed to assess any evidence of change. Change is considered any amount of signal difference from either RPC or Bobbin that is not attributed to eddy current testing (ECT) process tolerances. This evaluation is based on

present data compared to a minimum of two (2) cycles of historical data. With the exception of the tube-to-tube wear (TTW) indications, most of the RPC called volumetric indications (SVI or MVI) typically do not change outside the repeatability limits of eddy current examinations. The following table identifies the number of tubes plugged during U1R11 for each steam generator and their specific classification for plugging. No volumetric indications determined to be corrosion-related were left in service.

Table 2

Plugged SVI/MVI

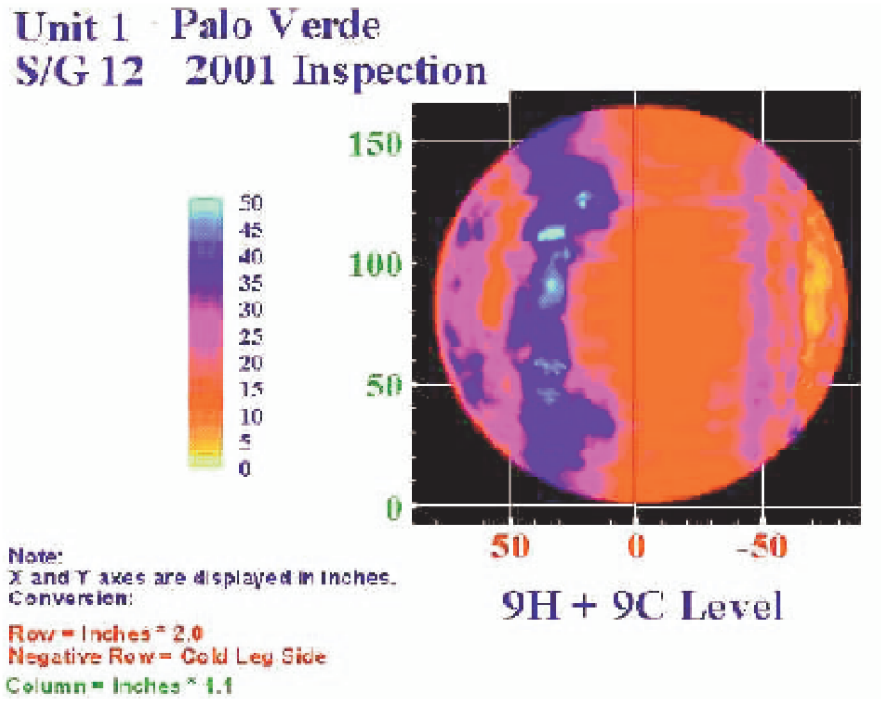
Classification:	SG 11	SG 12
VID – volumetric ID	6	3
PIT	2	
MBM	1	
TTW – tube to tube wear		4
TOTAL	9	7

NRC Staff Question 4

Were all of the indications in the cold-leg ARC at the tube supports? Were all of the indications detected with the bobbin coil (during the normal routine analysis)? If not, discuss your basis for not expanding the scope of your rotating probe examinations in the cold-leg ARC region.

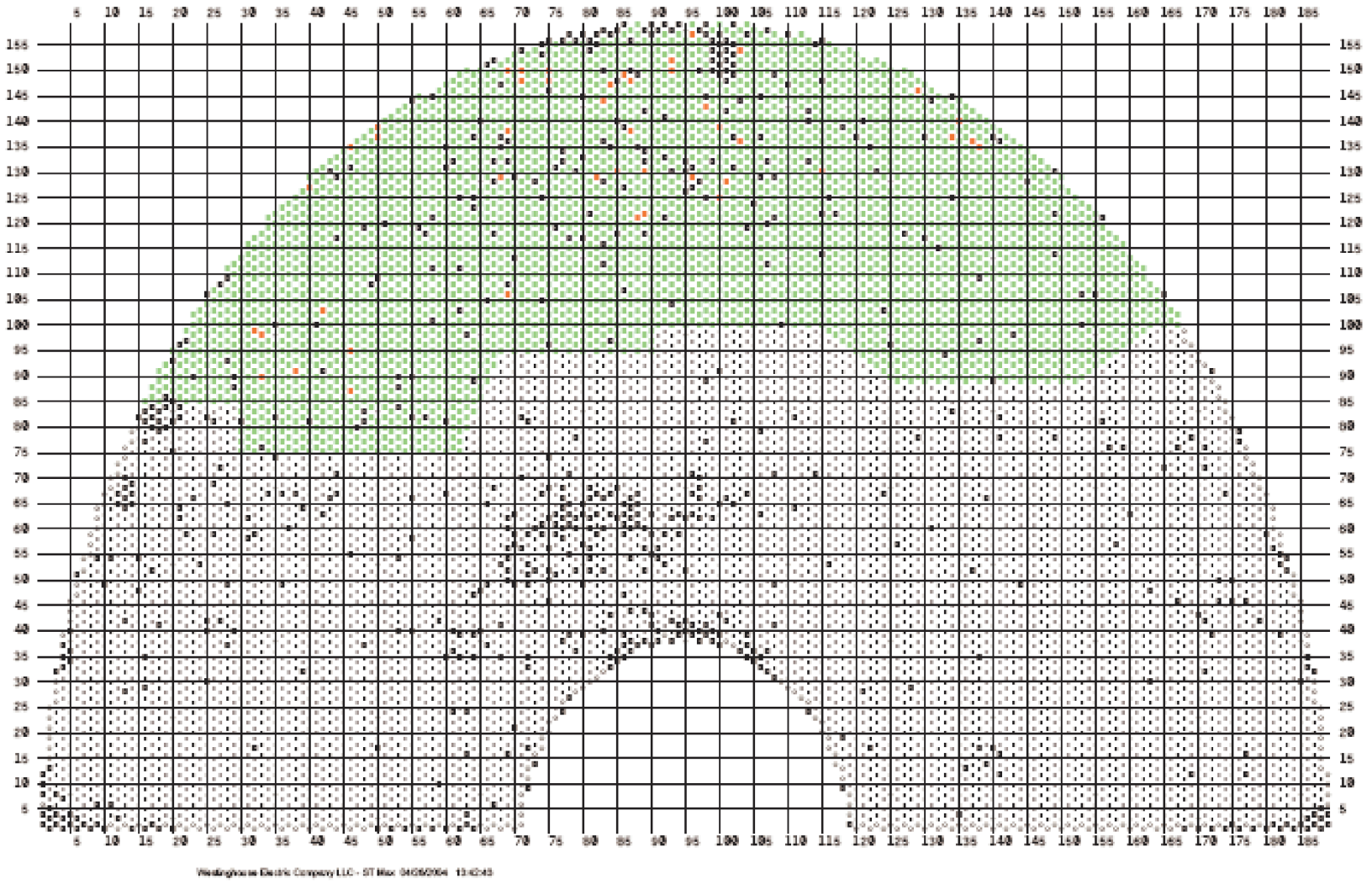
APS Response

Yes, all of the axial indications noted during cold-leg ARC examinations were at structures. Axial outer-diameter stress corrosion cracking (ODSCC) was first observed via bobbin coil inspection in the cold leg upper bundle region in U1R10. Unit 1 has been the only Palo Verde unit to observe such findings. In U1R10, the rotating probe examination was expanded to include an additional 464 inspections. There were no freespan ODSCC indications found during that inspection. Based on the U1R10 results, APS performed a degradation assessment and found that the bobbin detected support indications were within a region on the cold leg coincident with moderate scale deposition. This conclusion was reached based on scale profiling results performed prior to chemical cleaning (See Figure). Based on the assessment, APS planned a 25% RPC (~600 tubes per steam generator) inspection from 07C-VS5 during U1R11. Additionally, approximately 100 cold leg bends per steam generator were also inspected as part of Palo Verde's wear confirmation program. No freespan indications were identified. Therefore, greater than 1800 inspections have been performed over two inspection campaigns with no freespan indications found. The only flaws found by RPC and not called by bobbin coil were at support locations. The maximum depth of these indications were consistent with bobbin coil probability of detection. No structurally significant indications were missed by the bobbin coil. In steam generator 11, 5 of the 11 were detected with bobbin. The maximum depth of indications in each tube not detected by bobbin were sized at: 39, 43, 38, 43, 38, and 33%. In steam generator 12, 3 of the 14 were detected with bobbin. The maximum depth of indications in each tube not detected were sized at: 30, 39, 11, 31, 35, 35, 30, 32, 39, 33, and 33%. In the Cycle 12 Operational Assessment, APS concluded that the bobbin coil provided sufficient POD in this region and no structural or leakage integrity issues were identified.


Unit 1 Palo Verde
S/G 12 2001 Inspection
50
45
40
35
30
25
20
15
10
5
0
150
100
50
0
50
0
-50
9H + 9C Level
Note:
X and Y axes are displayed in inches.
Conversion:
Row = Inches * 2.0
Negative Row = Cold Leg Side
Column = Inches * 1.1

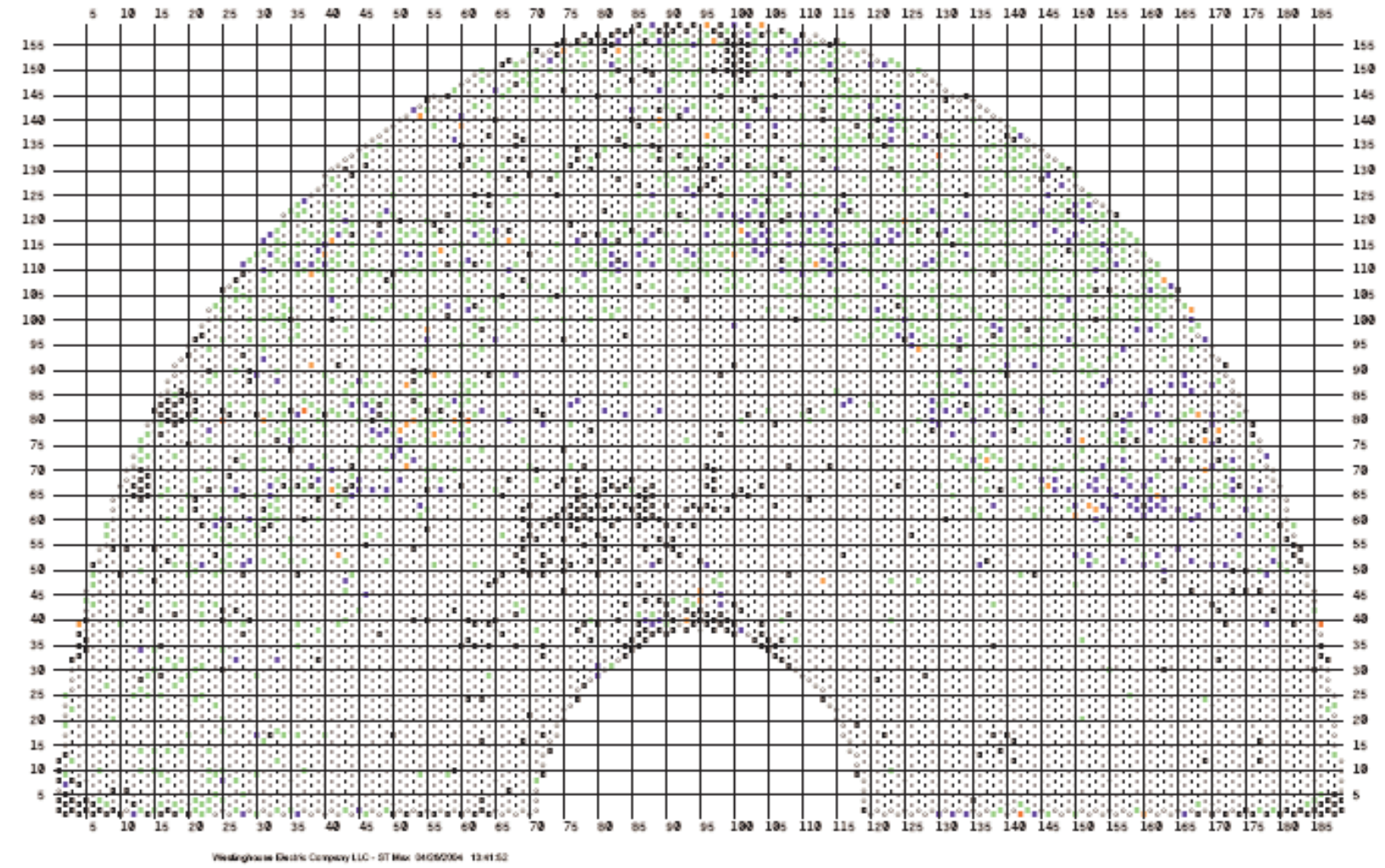
SG - 11 ARC REGION WITH AXIAL INDICATIONS

Palo Verde U1R11 PVNGS1 80



SG - 11 PERCENT INDICATION MAP BOBBIN AND MRPC

Palo Verde U1R11 PVNGS1 80



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