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AUTH.NAME AUTHOR AFFILIATION

LEVINE,J.M. Arizona Public Service Co. (formerly Arizona Nuclear Power

RECIP.NAME RECIPIENT AFFILIATION

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SUBJECT: Responds to NRC 970911 RAI re util proposed TS amend,
describing eddy current insp criteria for SG tubes without
particular reference to sleeve insps.Marked-up & re-typed
pages of PVNGS TS,encl.

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Palo Verde Nuclear
Generating Station

James M. Levine
Senior Vice President
Nuclear

TEL (602)393-5300
FAX (602)393-6077

Mail Station 7602
P.O. Box 52034
Phoenix, AZ 85072-2034

102-04186-JML/AKK
September 27, 1998

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Dear Sirs:

**Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket Nos. STN 50-528/529/530
APS Response to Request for Additional Information
Regarding Proposed Technical Specification Amendment
for Steam Generator Tube Slewing**

The enclosure to this letter provides the additional information regarding Arizona Public Service Company's (APS) proposed Technical Specification Amendment for Steam Generator Tube Slewing for the Palo Verde Nuclear Generating Station, Unit Nos. 1, 2 and 3, that was requested in your letter to APS dated September 11, 1997.

This letter does not make any commitments to the NRC. Please contact Mr. Scott Bauer at (602) 393-5978 if you have any questions or would like additional information regarding this matter.

Sincerely,

Enclosure

JML/SAB/RMW/rjh

cc: E. W. Merschoff
M. B. Fields
J. H. Moorman
A. V. Godwin

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ENCLOSURE

**APS Response to Request for Additional Information
Regarding Proposed Technical Specification Amendment
for Steam Generator Tube Sleaving**

NRC Request 1

The proposed TS changes describe eddy current inspection criteria for steam generator (SG) tubes without particular reference to sleeve inspections. Without explicit inspection criteria in the TS, the requirements for the initial sample scope and subsequent expansion criteria for sleeve inspections would be based on existing TS requirements (e.g., 3% initial sample scope). The staff believes that the proposed TS do not provide adequate inservice inspection (ISI) of sleeved steam generator tubes, and that the inspection and expansion criteria in the EPRI Steam Generator Tube Examination Guidelines should be satisfied, as a minimum, for all sleeved tubes. Please provide appropriate wording in the TS reflecting this criteria. For reference, a previously adopted table incorporated in the TS for another licensee is attached.

Further, several TS sections (4.4.4.2; 4.4.4.3.b; 4.4.4.3.c and 4.4.4.4.b) will be affected and need to be modified when a separate table is generated for sleeve inspections.

APS Response

In Arizona Public Service Company's (APS) response to Generic Letter 97-05 "Steam Generator Tube Inspection Techniques" (Reference 3), APS committed to implement Nuclear Energy Institute (NEI) 97-06, *Steam Generator Program Guidelines*, for all steam generator inspections that are to be performed after January 1, 1999. Implementation of this guideline at PVNGS requires APS to meet the intent of *EPRI PWR Steam Generator Examination Guidelines*. The requirements in the EPRI guideline for inspection technique and analyst qualification, inspection scope, expansion criteria and degradation assessment assure that the condition of the steam generator tubing and associated repairs, such as sleeving and plugging, satisfy the PVNGS licensing basis with respect to reactor coolant pressure boundary integrity.

The objective of NEI 97-06 is to provide flexibility within each plant-specific steam generation degradation management program such that adjustments may be made to the program to accommodate the type and degree of degradation experienced at that facility. NEI 97-06 also provides a method for implementing the expected improvements in inspection techniques that are used to identify and manage steam generator degradation. In addition, APS regards the suggested table to be oversimplified and restrictive. Implementing this table, as suggested, may lead to issues similar to those that exist with the current Technical Specifications and may not necessarily satisfying the overall objective of ensuring end of cycle pressure boundary integrity. APS recognizes that the NRC staff is developing and proposing a generic letter, which includes suggested technical specifications for steam generator management, and a regulatory guide that describes an approach for monitoring and maintaining steam generator tubing such that steam generator integrity is assured. However, this information has not yet been provided for public comment or issued to the licensees. Therefore, APS is reluctant to incorporate any additional information into the Technical Specifications, other than the proposed amendment request,

pending the issuance of these documents. APS' commitment to implement NEI 97-06 and the Technical Specifications, including this amendment request, provide for a very strong steam generator degradation management program that assures steam generator integrity. Therefore, APS does not intend to implement the suggested change with respect to eddy current inspection criteria in this amendment request.

NRC Request 2

Describe the extent to which APS subscribes to the EPRI PWR Steam Generator Tube Examination Guidelines. For example, does APS use the Appendix G, "Qualified Personnel", and Appendix H, "Qualified Techniques", in the EPRI Guidelines?

APS Response

APS has committed to implement the guidance provided in NEI 97-06, *Steam Generator Program Guidelines*, for all steam generator inspections that are performed after January 1, 1999. This commitment requires APS to comply with the EPRI *PWR Steam Generator Examination Guidelines*, including Appendix G, "Qualified Personnel", and Appendix H, "Qualified Techniques". Subscribing to the EPRI guideline has been a long-term objective of the PVNGS steam generator degradation management program. APS' efforts to implement the EPRI guideline have been recognized by the NRC (NRC Inspection Report 94-15 (Reference 4)). In addition, APS has docketed a commitment to this guideline in APS responses to Generic Letters 95-03 (Reference 5) and 97-06 (Reference 6), and the APS response to the Request for Additional Information regarding monitoring and operational assessment of steam generators for Palo Verde Unit 2 and continued operability of steam generators for Palo Verde Units 1 and 3 (Reference 7). These documents, and other documents, indicate a long-term commitment to the use of qualified eddy current inspection techniques and analysts at PVNGS.

NRC Request 3

Describe the approach APS plans for adopting new and improved eddy current techniques for sleeve inspections.

APS Response

The eddy current testing inspection program for the PVNGS steam generators has continued to advance through the evolution of state of the art equipment, technique development and industry experience. APS has employed the appropriate ASME Code and Regulatory Guide requirements, as well as the supplementary guidance of the EPRI *PWR Steam Generator Examination Guidelines*, to develop a steam generator degradation management program whose leadership is recognized by the industry.

As previously stated, APS will implement NEI 97-06, *Steam Generator Program Guidelines*, for all steam generator inspections that are performed after January 1, 1999. As specified in NEI 97-06, each utility is required to follow the inspection guidelines contained in the latest revision of the EPRI *PWR Steam Generator Examination Guidelines*. The EPRI guideline recommends applying the guidance found in EPRI *PWR Sleeve Assessment Document* when sleeve inspections are performed. APS will implement the most appropriate sleeve inspection techniques that are capable of detecting and assessing the type of degradation conditions that are experienced in the PVNGS steam generators. Implementation of these techniques will demonstrate end-of-cycle sleeve and parent tube integrity. The PVNGS steam generator degradation management program will comply with, or exceed, the EPRI *PWR Steam Generator Examination Guidelines*, along with the EPRI *PWR Sleeve Assessment Document*, as required by NEI 97-06.

NRC Request 4

Recent experience at the Kewaunee nuclear plant showed that visual test (VT) examinations of welded freespan joints may detect significant process-induced defects that were not detectable or resolvable by ultrasonic tests (UT) or eddy current (EC) examinations. The ABB-CE report discussed two VTs associated with the sleeving process, but does not specifically state that a VT is required. Clarify if APS will perform a VT in accordance with the topical report and how often a VT will be performed. If a VT will not be performed, provide the details of the nondestructive examination qualification efforts that justify the use of UT and EC inspections, without a VT, as a sufficient means to demonstrate acceptable sleeve weld quality.

APS Response

The ABB-CE topical report identified two visual inspections associated with the ABB-CE sleeving process. The first inspection is performed after the process of brush cleaning the weld region prior to sleeve installation. The second inspection is an optional inspection (as described in Section 5 of the ABB-CE topical report) of the sleeve-to-tube weld and is conducted as a VT-1 visual inspection per Section XI of the ASME Code.

APS has opened an internal commitment in the APS licensing commitment tracking system to implement both the required and recommended process inspections into the appropriate station sleeving procedures when they are developed for PVNGS. In accordance with the ABB-CE topical report, three types of NDE examinations will be conducted after the completion of the sleeve-to-tube weld for all installed sleeves. These inspections consist of ultrasonic testing (UT), eddy current testing (ECT) and a visual inspection (VT-1). APS will require a VT-1 inspection of each sleeve-to-tube weld until sufficient data has been obtained with UT and ECT techniques that

demonstrates that these techniques are capable of detecting and resolving uncertainties in the weld joint.

NRC Request 5

APS stated in TS Bases Section 3/4.4.4 that it will perform post weld heat treatment (PWHT) to the sleeve weld joints. The staff believes that commitments made in the Bases section are subject to change under 10 CFR 50.59 and, therefore, are inappropriate for inclusion in staff safety evaluations. The staff requests APS incorporate the commitment to perform PWHT in the surveillance requirements section of TS, preferably in TS Section 4.4.4.4. As an alternative, APS may submit for staff review an evaluation that demonstrates the acceptability of weld joints integrity without PWHT.

APS Response

APS has opened an internal commitment in the APS licensing commitment tracking system to implement the requirement to perform a PWHT for sleeve installations into the appropriate station sleeving procedures when they are developed for PVNGS. APS does not intend to incorporate this requirement into the technical specification since situations may arise during the sleeving process that would prohibit the performance of a PWHT on some sleeve installations. Examples of these infrequent situations include limited access areas within the steam generators where there is insufficient space to accommodate the PWHT tooling and situations where PWHT tooling problems develop that preclude the timely completion of the PWHT. In these situations, APS will perform an engineering evaluation of the as-welded condition of the sleeve to determine the acceptability of the sleeve installation prior to returning the affected steam generator to service. Although a PWHT is preferred over the as-welded condition (due to lower residual stresses), CE Topical Report No. CEN-630-P, Rev 01 (Section 6.2) provides tests and analyses that assess the acceptability of as-welded sleeve-to-tube joints. The increased stresses in the as-welded joint have the effect of reducing sleeve joint life. In addition, the tube samples used in the ABB-CE testing are conservative when compared to the tubing installed at PVNGS. Therefore, APS believes that there will not be any sleeve installation/tube integrity issues that would limit plant operation with respect to the operating cycle following the sleeve installation. The PVNGS steam generator degradation management program will assess continued operation of the sleeve repair through inspection, condition monitoring, degradation assessment and operational assessment, as required per NEI 97-06.

NRC Request 6

The current TS Limiting Condition for Operation (LCO) 3.4.5.2.c specifies an allowable leakage of 1 gpm for the total primary-to-secondary leakage through all steam generators and 720 gallons per day through any one steam generator. The NRC staff position regarding operational leakage limits is that allowable operational leakage limits should be reduced to 150 gallons per day through any one steam generator when sleeving of steam generator tubes is performed. Please revise the TS accordingly.

APS Response

APS will implement NEI 97-06, *Steam Generator Program Guidelines*, for all steam generator inspections that are performed after January 1, 1999. Section 3.5 of NEI 97-06, "Primary-To-Secondary Leakage Monitoring", states:

"Licensees shall establish primary-to-secondary leakage monitoring procedures in accordance with the EPRI Primary-to-Secondary Leak Guidelines. Licensees shall initiate plant shutdown in a controlled and timely manner prior to exceeding 150 gallons per day (GPD) or when the leak rate increase exceeds 60 GPD in any one-hour period. This measurement should be confirmed using a qualitative method (e.g. steam generator blowdown radiation monitors, main steam line monitors, etc....)."

Furthermore, APS has previously committed to the NRC to implement an administrative RCS operational leakage limit that would require a unit shutdown that is more conservative than the limit recommended in the EPRI guideline. This limit, which applies to all three units, is 50 GPD through any one steam generator (References 8 and 9). As stated previously, APS recognizes that the NRC staff is developing and proposing a generic letter, which includes suggested technical specifications for steam generator management, and a regulatory guide that describes an approach for monitoring and maintaining steam generator tubing such that steam generator integrity is assured. The draft documents of the generic letter and the regulatory guide recommend an operational leakage limit of 150 GPD through any one steam generator. However, this information has not yet been provided for public comment or issued to the licensees. Therefore, APS is reluctant to incorporate any additional information into the Technical Specifications, other than the proposed amendment request, pending the issuance of these documents. APS' commitment to implement NEI 97-06, the Technical Specifications (including this amendment request) and a long-standing previous commitment to the NRC for implementing a very conservative administrative RCS operation leakage limit provides for a very strong steam generator degradation management program that assures steam generator integrity. Therefore, APS does not intend to implement the suggested change with respect to RCS operational leakage limits in this amendment request.

NRC Request 7(a)

APS has proposed a plugging limit for ABB-CE sleeves of 35% of the nominal sleeve wall thickness. This is documented in the proposed TS. However, the topical report, CEN-630-P, calculated a "% allowable degradation" that is different from 35%. Please clarify the basis for the 35% TS limit, and its relation to the calculated value in the topical report.

APS Response

The basis for the 35% repair limit for ABB-CE sleeves was provided in the original APS request for this technical specification amendment request, which was submitted in April 1995 (Reference 2). The technical justification for this repair limit was provided as Attachment 3 to the original amendment request. This information was inadvertently omitted from the revised amendment request that was submitted in May 1997 (Reference 1). The ABB-CE topical report, although considered bounding for CE plants, does not consider allowances for non-destructive examination (NDE) uncertainties and defect growth rates, as required by Regulatory Guide 1.121 for establishing repair limits. As such, APS has elected to develop a PVNGS-specific % allowable degradation that incorporates plant-specific operating parameters. Appropriate allowances for NDE uncertainties and defect growth rates are then incorporated, resulting in a repair limit of 35%, which is lower than the original parent tube repair limit. Although this repair limit is considered to be a maximum limit for degradation of the sleeve, sleeve inspections, condition monitoring, degradation assessment and operational assessment, as required per NEI 97-06, may require sleeves to be repaired or taken out of service at degradation conditions that are lower than the 35% limit.

The pertinent information that was submitted in Attachment 3 of the original technical specification amendment request is provided below. This information has been updated since the original amendment request took exception to the Palo Verde-specific ABB-CE report CEN-613-P, rather than to the current generic ABB-CE topical report CEN-630-P.

Exceptions to Combustion Engineering Inc. Report CEN-630-P, Revision 1:

1. Regulatory Guide 1.121 Plugging Limit for CE Leak Tight Sleeves

Section 8.3, *Evaluation for allowable sleeve wall degradation using Regulatory Guide 1.121*, determines the minimum acceptable wall thickness for leaving a degraded tube (sleeve) in service. However, the analysis does not consider allowances for NDE measurement error and defect growth rate as required by Regulatory Guide 1.121 for establishing the repair limit.

In Section 8 of CEN-630-P, ABB-CE elected to define bounding design conditions on a generic basis. This definition provided results that are conservative for PVNGS. However, APS elected to perform a separate plant-specific assessment for establishing the sleeving repair limit. None of the other structural assessments in the ABB-CE topical report are affected by this evaluation. Consequently, for the purposes of this evaluation, the pressure conditions listed below are specific to PVNGS.

From pages 8 and 9 of CEN-630-P:

Primary Pressure $P_{pri} = 2250$ psig

Secondary Pressure $P_{sec} = 980$ psig

Differential Pressure $\Delta P = P_{pri} - P_{sec} = 1270$ psi

Average Pressure $P_{ave} = 0.5 (P_{pri} + P_{sec}) = 1615$ psi

$t = 3\Delta P R_{IS} / S_u - P_{ave} = 3 (1.270) (0.281) / 80.0 - 1.615 = \underline{0.0136 \text{ inch}}$

% allowable degradation = $0.0300 - 0.0136 / 0.0300 = \underline{54.67 \%}$

The Palo Verde-specific % allowable degradation for the $3\Delta P$ criterion calculated above is more limiting than the 57.0% allowable degradation for Main Steam Line Break that is provided in CEN-630-P.

In establishing the PVNGS repair criteria for ABB-CE Leak Tight Sleeves, an allowance for NDE uncertainties and defect growth rate was applied in accordance with Regulatory Guide 1.121. The original PVNGS Technical Specification 40% repair criteria (which applies to Alloy 600 steam generator tubing) provided a 10% allowance for ECT uncertainties and a 10% allowance for defect growth rate/fuel cycle in establishing the plugging limits. These allowances for NDE uncertainties and defect growth rates are considered to be typical upper bound values and are conservative. Based on the above calculation, and applying similar allowances results in a plugging limit for sleeve wall defects of 34.67%. As a result, APS has incorporated a 35%

plugging limit for ABB-CE sleeves in this amendment request. Rounding the calculated plugging limit value up is conservative due to the enhanced corrosion resistance of the Alloy 690 material used to fabricate the sleeves and recent, continuing improvements in ECT probe design and resolution techniques. If, during condition monitoring and operational assessment, actual values for these allowances are found that exceeds these assumptions, APS will administratively implement more restrictive repair criteria to assure end of cycle tube integrity. This approach is consistent with the NEI 97-06 guideline. Past examples of the types of degradation that resulted in APS imposing more restrictive repair criteria at PVNGS can be found in the APS response to Generic Letter 97-05 (Reference 3).

NRC Request 7(b)

The associated proposed TS Section 4.4.4.4.a.7.b does not clearly document that the plugging limit is 35% of the sleeve wall thickness. Please modify the proposed TS to address this. The following wording for TS Section 4.4.4.4.a.7.b would clarify the matter: "b. ABB-CE Leak Tight Sleeve Wall 35%".

APS Response

The suggested change has been incorporated into Technical Specification Section 5.5.9.4.a.7.b of the amendment request.

NRC Request 8

As part of the TS amendment request to use ABB-CE sleeves, APS submitted two proposed revisions of TS changes. The first version proposed changes to the current, approved TS. The second version proposed changes to the Improved TS. The staff will only review the proposed changes associated with the current TS. The Improved TS are being reviewed under a separate TS amendment request. The proposed sleeve inspection changes to the Improved TS should be submitted under that TS amendment request. The staff suggests that the TS issues addressed in this Request for Additional Information also be addressed in the Improved TS.

APS Response

Technical Specification Amendment 117, which became effective August 13, 1998, implemented the Improved Technical Specifications for PVNGS. Therefore, APS has provided the appropriate marked-up, and copies of the re-typed, pages of the Technical Specifications as an attachment. The responses provided to Questions 1 through 7 remain valid and apply to Amendment 117 of the PVNGS Technical Specifications. Please note that the marked-up pages have been modified slightly to include APS' commitment to implement the guidance provided in NEI 97-06 (see Section 5.5.9).

References

1. APS letter 102-03938-JML/AKK/JRP to NRC, *Revised Technical Specification Amendment Request Sleeving Process for Steam Generator Tube Repair*, dated May 23, 1997.
2. APS letter 102-03325-WLS/SAB/JRP to NRC, *Technical Specification Amendment Request Sleeving Process for Steam Generator Tube Repair*, dated April 18, 1995.
3. APS letter 102-04094-JML/SAB/RMW to NRC, *Response to Generic Letter 97-05: "Steam Generator Tube Inspection Techniques"*, dated March 13, 1998.
4. NRC Inspection Report 94-15, dated June 23, 1994.
5. APS letter 102-03401-WLS/AKK/JRP to NRC, *Response to Generic Letter 95-03, Circumferential Cracking of Steam Generator Tubes*, dated June 25, 1995.
6. APS letter 102-04103-JML/SAB/RMW to NRC, *Response to Generic Letter 97-06: "Degradation of Steam Generator Internals"*, dated March 30, 1998.
7. APS letter 102-04040-JML/AKK/JRP to NRC, *Response to Request for Additional Information Regarding Monitoring and Operational Assessment of Steam Generators for Palo Verde Unit 2 and Continued Operability of Steam Generators for Palo Verde Units 1 and 3*, dated November 18, 1997.
8. APS letter 102-02569-WFC/JRP to NRC, *Unit 2 Steam Generator Tube Rupture Analysis Report*, dated July 18, 1993.
9. APS letter 102-03465-WLS/SAB/JRP to NRC, *Palo Verde Nuclear Generating Station Unit 2 Steam Generator Evaluation – August 1995*, dated September 7, 1995.

Attachment

**Marked-Up and Re-Typed Pages of the
PVNGS Technical Specifications**

Page 5.0-12, Insert A:

This program implements the guidance of Nuclear Energy Institute (NEI) 97-06, Steam Generator Program Guidelines, and provides controls for the inservice inspection of steam generator tubes to ensure that structural integrity of this portion of the RCS is maintained. This program shall include the following:

Page 5.0-15, Insert B:

6. Plugging or Repair Limit means the imperfection depth at or beyond which the tube shall be removed from service by plugging or repaired by sleeving in the affected area. The plugging or repair imperfection depths specified below are in percentage of nominal wall thickness:

a. Original tube wall	40%
b. Leak tight sleeve wall	35%

Page 5.0-15, Insert C:

10. Tubing or Tube means that portion of the tube or sleeve that forms the primary system to secondary system pressure boundary.
11. Tube Repair refers to welded sleeving, as described in ABB-CE Report CEN-630-P, "Repair of 3/4" O.D. Steam Generator Tubes Using Leak Tight Sleeves", Revision 1, dated November 1996, which is used to maintain a tube in service or to return a previously plugged tube to service. Returning a previously plugged tube to service includes the removal of the tube plugs that were installed as a preventive or corrective measure and performing a tube inspection of the tube in accordance with Technical Specification 5.5.9.4.a.8.

Page 5.0-15, Insert D:

Defective tubes may be repaired in accordance with ABB-CE Report CEN-630-P, "Repair of 3/4" O.D. Steam Generator Tubes Using Leak Tight Sleeves", Revision 1, dated November 1996.

