July 25, 2000

Mr. Gregg R. Overbeck
Senior Vice President, Nuclear
Arizona Public Service Company
P. O. Box 52034
Phoenix, AZ 85072-2034

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3 - RELIEF REQUEST NUMBER 12 FOR THE SECOND 10-YEAR PUMP AND VALVE INSERVICE TESTING PROGRAM (TAC NOS. MA7740, MA7741, AND MA7742)

Dear Mr. Overbeck:

In its letter of November 30, 1999, Arizona Public Service Company submitted Relief Request No. 12 related to the second 10-year interval inservice testing program for pumps for the Palo Verde Nuclear Generating Station, Units 1, 2, and 3. The staff has reviewed the proposed alternative testing method in this relief request against the requirements of the American Society of Mechanical Engineers Section XI Code, which references Operations and Maintenance Standards Part 6 for pumps.

The staff has concluded that the proposed alternative is not authorized because the relief request did not provide the specific information required for the staff to make an evaluation for the pumps affected by the proposed alternative. The staff will reconsider the proposed alternative if specific information is provided on the pump and vibration parameter for which alternative testing is proposed that would demonstrate that compliance with the code requirements would result in a hardship without a compensating increase in the level of quality and safety.

The enclosure provides the staff's evaluation and conclusions on the proposed relief request from code requirements.

Sincerely,

/RA/

Stephen Dembek, Chief, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-528, STN 50-529,
and STN 50-530

Enclosure: Safety Evaluation

cc w/encl: See next page

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Senior Vice President, Nuclear
Arizona Public Service Company
P. O. Box 52034
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Mel B. Fields, Project Manager, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NUMBER 12

FOR THE SECOND 10-YEAR PUMP AND VALVE INSERVICE TESTING PROGRAM

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3

DOCKET NOS. STN 50-528, STN 50-529, AND STN 50-530

1.0 INTRODUCTION

By application dated November 30, 1999, the Arizona Public Service Company (the licensee) submitted Relief Request No. 12 related to the second 10-year interval inservice testing (IST) program for pumps for the Palo Verde Nuclear Generating Station Units 1, 2, and 3. The staff has reviewed the proposed alternative testing method in this relief request against the requirements of the American Society of Mechanical Engineers (ASME) Section XI Code, which references Operations and Maintenance Standards Part 6 for pumps.

2.0 BACKGROUND

The *Code of Federal Regulations*, 10 CFR 50.55a, requires that IST of certain ASME Code Class 1, 2, and 3 pumps and valves be performed in accordance with Section XI of the ASME *Boiler and Pressure Vessel Code* (the code) and applicable addenda, except where alternatives have been authorized or relief has been requested by the licensee and granted by the Commission pursuant to paragraphs (a)(3)(i), (a)(3)(ii), or (f)(6)(i) of 10 CFR 50.55a. In proposing alternatives or requesting relief, the licensee must demonstrate that (1) the proposed alternatives provide an acceptable level of quality and safety, (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety, or (3) conformance is impractical for its facility. Section 50.55a authorizes the Commission to approve alternatives and to grant relief from ASME code requirements upon making the necessary findings. NRC guidance contained in Generic Letter (GL) 89-04, “Guidance on Developing Acceptable Inservice Testing Programs,” provides alternatives to the code requirements that are acceptable. Further guidance is given in GL 89-04, Supplement 1, and NUREG-1482, “Guidelines for Inservice Testing at Nuclear Power Plants.”

The second 10-year interval for the Palo Verde units began on January 15, 1998, and is scheduled to end January 14, 2008. The IST program was developed in accordance with the requirements of the 1989 Edition of the ASME Section XI Code which references

ASME/American National Standards Institute *Operations and Maintenance (OM) Standards* Part 6 and Part 10 (OM-6, and OM-10) for IST of pumps and valves respectively.

3.0 EVALUATION

The licensee has requested relief from the test procedure requirements of paragraph 5.2(d) and the acceptance criteria requirements of paragraph 6.1 for the pumps from each unit listed below. The licensee has proposed to analyze the vane pass vibration frequency by using spectral analysis and spectral band monitoring when a pump vibration parameter exceeds 0.325 inch per second (ips). If the analysis concludes that the pump performance is acceptable, new reference values will be established for the frequency band below the vane pass frequency, the frequency band at the vane pass frequency, and the frequency band above the vane pass frequency.

Pump ID	Pump Description
AFA-P01	Essential Auxiliary Feedwater Pump (Turbine-Driven)
AFB-P01	Essential Auxiliary Feedwater Pump (Motor-Driven)
AFN-P01	Non-Class Auxiliary Feedwater Pump (Motor-Driven)
CTA-P01	Condensate Transfer Pump
CTB-P01	Condensate Transfer Pump
ECA-P01	Essential Chilled Water Circulating Pump
ECB-P01	Essential Chilled Water Circulating Pump
EWA-P01	Essential Cooling Water Pump
EWB-P01	Essential Cooling Water Pump
PCA-P01	Spent Fuel Cooling Pump
PCB-P01	Spent Fuel Cooling Pump
SIA-P01	Low Pressure Safety Injection Pump
SIB-P01	Low Pressure Safety Injection Pump
SIA-P02	High Pressure Safety Injection Pump
SIB-P02	High Pressure Safety Injection Pump
SIA-P03	Containment Spray Pump
SIB-P03	Containment Spray Pump
SPA-P01	Essential Spray Pond Pump
SPB-P01	Essential Spray Pond Pump

3.1 Licensee's Basis for Requesting Relief

The licensee states:

> The pump spectra often exhibit amplitude "spikes" at several different frequencies. One very prominent spike occurs at vane pass frequency, which can be caused by flow induced hydraulic conditions. The magnitude of this spike can cause the broad-band vibration to exceed the Code Alert Range limit of 0.325 ips. These conditions are not indicative of pump degradation.
>
> The Unit 2 motor-driven Auxiliary Feedwater Pump, AFB-P01, is an example of a pump that is not designed to meet the current Code-required Alert Range limit (0.325 ips) in the vane passing frequency band. Broad-band vibration amplitude as high as 0.46 ips has been experienced when the pump has been operating acceptably in the past. The vibration is primarily composed of response at the vane-passing frequency of 299 Hz, or 5 times the running speed. The pump manufacturer, Sulzer Bingham, has verified that elevated readings in this frequency band are not indicative of pump degradation.

3.2 Alternative Testing

The licensee proposes:

> If vane-passing frequencies cause broad-band vibration to exceed 0.325 inches per second, (ips) commercial grade spectral analysis and spectral band monitoring shall be performed. The supporting analysis will include verification of the pump's operational readiness and an evaluation of the test data that verifies that the subject pump is not expected to fall below the minimum required performance level in the periods between testing. The analysis will include an evaluation of trends indicated by the available test and maintenance data. The results of this analysis will be documented in the record of tests. After verifying that the pump is acceptable, separate reference values and range limits will be established for the frequency band below the vane-passing frequency, the vane-passing frequency band, and the frequency band above the vane-passing frequency. The range limits for the bands above and below the vane-passing frequency will be as specified in Table 3 of OM-6 Code. The range limits for the vane-passing frequency band will be 2 to 4 times the Reference Value for the Alert Range, and greater than 4 times the Reference Value for the Action Required Range.

3.3 Staff Evaluation

The code requires that pump vibration parameters be compared with established reference values. If a deviation in any one of the measured vibration parameters exceeds the limiting alert value, as defined by the licensee in accordance with Table 3a of OM-6, then the test frequency is doubled until the cause of the deviation is determined and the condition corrected. For vibration reference values below 0.13 ips, the alert limit is 2.5 times the reference value (note: a Palo Verde alternative, proposed in Relief Request Number 8, was authorized in a safety evaluation dated July 8, 1999, to classify vibration parameters as "smooth-running" if

their reference values were below 0.05 ips). For reference values at or above 0.13 ips, the absolute alert limit acceptance criteria is 0.325 ips.

The Unit 2 motor-driven auxiliary feedwater pump appears to be operating in the alert range with at least one vibration parameter exceeding 0.325 ips. In addition, the licensee states that the major noise contributor associated with this parameter is at the vane pass frequency. The licensee has proposed a generic approach to this issue. The licensee stated that if overall vibration values exceed 0.325 ips, spectral analysis will be performed to identify the frequency and magnitude of the noise contributor. If this contributor is identified as vane pass, and the pump is demonstrated to be operating acceptably, separate acceptance criteria will be established for frequency bands at, above, and below the vane pass frequency.

Several licensees have noted increased vibration levels relative to the absolute acceptance criteria when updating their IST programs to incorporate the requirements of OM-6. In some instances, these levels were above the code alert and, in at least two cases, the required action absolute acceptance criteria. In all these cases, the increased level in overall vibration was determined, by the use of spectral analysis, to be attributable to increased vibration at the vane pass frequency. One known noise contributor for high vane pass frequency vibration is flow noise due to pump inlet flow recirculation. The performance of pump testing at low flow conditions promotes inlet recirculation and exacerbates this problem. At design or substantial flow conditions, the noise contribution from the vane pass frequency is significantly reduced due to the reduced inlet recirculation flow.

In this situation, the level of the overall vibration velocity at the test condition may not be detrimental to the operation of the pump and may not be an indication of pump degradation. The vibration magnitude may be indicative of historical performance at low flow operation. To resolve the issue of doubling the test frequency, a licensee typically proposes an alternative to the code absolute acceptance criteria. In the case of the absolute alert acceptance criterion, the licensee will state that it is a hardship to double the pump test frequency because the condition of the pump is acceptable. In its evaluation of these proposed alternatives, the staff evaluates the licensee's submittal to ensure it has demonstrated that (1) the measured vibration has historically operated at the current magnitude, (2) the vibration contributor causing this magnitude can be identified, (3) this vibration magnitude will not cause degradation from this contributor alone, and (4) degradation can be trended in the long term. Each licensee addresses the above criteria by reviewing historic vibration information, consulting with the pump manufacturer, evaluating current pump performance, and using spectral analysis to evaluate the noise contributors. Licensees typically describe actions attempted to lower the vibration levels. A number of proposed alternatives to use new vibration absolute alert acceptance criteria have been authorized when this specific information is provided and the condition of the pump is evaluated to be acceptable.

The licensee's proposed alternative testing is not consistent with similar alternatives submitted by other licensees and authorized by the staff. The precedent surrounding the issuance of previous relief requests on this subject was related to the conversion of pump vibration testing to OM-6. Palo Verde's methodology would make this a permanent fixture for all pumps. The intent of the previously approved alternatives was to address certain pump vibration parameters that were susceptible to increased vibration at low flow conditions; but when the pump operated at substantial or design flow conditions, the high vibration values due to vane pass frequency disappeared, demonstrating that this phenomenon was a product of the amplification of

vibration at the vane pass frequency due to inlet flow recirculation. The licensee's proposed alternative would allow this type of analysis to be applicable at high flow conditions where measured vibration values may be an indication of actual degradation. The current code requirements are adequate to measure overall vibration at substantial flow conditions.

It appears that the licensee has issues with certain pumps such that an alternative could be authorized provided that the licensee submits the appropriate information as described above. The licensee may wish to resubmit this relief request with specific information on each pump and vibration parameter for which an alternative is proposed. The alternative in its current form lacks sufficient detail for the staff to reach a finding that compliance with the code requirements would result in a hardship without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

Based on the evaluation provided above, the staff concludes that the licensee's proposed alternative is not authorized. The licensee may wish to resubmit this relief request with specific information on the pump and vibration parameter for which alternative testing is proposed that would demonstrate that compliance with the code requirements would result in a hardship without a compensating increase in the level of quality and safety.

Principal Contributor: J. Colaccino

Date: July 25, 2000