UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 21, 2010

Mr. Randall K. Edington
Executive Vice President, Nuclear
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SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3, LICENSE RENEWAL APPLICATION (TAC NOS. ME0254, ME0255, AND ME0256)

Dear Mr. Edington:

By letter dated December 11, 2008, as supplemented by letter dated April 14, 2009, Arizona Public Service Company (APS) submitted an application pursuant to Title 10 of the *Code of Federal Regulations* Part 54 to renew Operating License Nos. NPF-41, NPF-51, and NPF-74 for the Palo Verde Nuclear Generating Station, Units 1, 2, and 3, respectively. The staff is reviewing the information contained in the license renewal application and has identified in the enclosure areas where additional information is needed to complete the review. Further requests for additional information may be issued in the future.

A mutually agreeable date for your response, as discussed with Angela Krainik of APS staff, was determined to be 30 calendar days from the date of this letter. If you have any questions, please contact me at 301-415-1906 or by e-mail at Lisa.Regner@nrc.gov.

Sincerely,

Lisa M. Regner, Sr. Project Manager
Projects Branch 2
Division of License Renewal
Office of Nuclear Reactor Regulation

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

Enclosure:
As stated

cc w/encl: See next page

PALO VERDE NUCLEAR GENERATING STATION
LICENSE RENEWAL APPLICATION
REQUEST FOR ADDITIONAL INFORMATION

RAI 4.3-7

Background:
In license renewal application (LRA) Amendment 14, the applicant amended LRA Table 4.3-4. In the table, the applicant credits the following enhanced fatigue aging management program (AMP) monitoring bases for American Society of Mechanical Engineers (ASME) Code Class 1 components:

- Stressed based fatigue (SBF) monitoring as the 10 CFR 54.21(c)(1)(iii) aging management monitoring basis for the pressurizer surge line elbow, which is the limiting environmentally-assisted fatigue location (i.e., limiting NUREG/CR-6260 location)
- Cycle based fatigue –partial cycle (CBF-PC) monitoring as the 10 CFR 54.21(c)(1)(iii) aging management monitoring basis for the pressurizer spray nozzles, which are the limiting non-environmental CUF components for the current fatigue aging management program (with a limiting design basis cumulative usage factor (CUF) value of 0.9923)

Issue:
The staff noted that under the amended basis in LRA Table 4.3-4, as given in LRA Amendment 14, the applicant currently credits SBF monitoring only for 10 CFR 54.21(c)(1)(iii) management of the pressurizer surge line elbow, which according to the LRA is the limiting ASME Code Class 1 location for environmentally-assisted fatigue. For the current fatigue AMP, the pressurizer spray nozzles are the limiting ASME Code Class 1 component (with a limiting design basis CUF of 0.9923). The updated table does not credit SBF for this limiting component.

Request:
Justify your basis for not evaluating the pressurizer spray nozzles for environmentally assisted fatigue, when considering that the pressurizer spray nozzle has a limiting design basis CUF of 0.9923.

RAI 4.3-8

Background:
In LRA Amendment 14, dated April 28, 2010, the applicant updated LRA Tables 4.3-2 and 4.3-3. In the updated LRA Table 4.3-2, the applicant lists Transient 17, "Initiation of Auxiliary Spray," as an applicable normal operating condition transient. In the updated LRA Table 4.3-3, the applicant stated that the tracking of Transient 17 will be correlated to the tracking of pressurizer cooldown events, which is listed in these updated tables as Transient 12, "Pressurizer cooldown from 563 degrees F to 70 °F at a rate of ≤ 200 °F/hr."

Issue:
It is not clear to the staff whether Transient 17, is referring to an initiation of the pressurizer spray system or an initiation of the containment spray system. It is also not clear to the staff why it is valid to correlate the tracking of Transient 17 to the tracking of Transient 12.

Request:
Clarify whether Transient 17 is referring to an initiation of the pressurizer spray system or an initiation of the containment spray system. Provide your basis for why it is valid to correlate the tracking of Transient 17 to the tracking of Transient 12.

RAI 4.3-9

Background:
LRA Amendment 14, dated April 28, 2010, the applicant updated LRA Table 4.3-3. In this table, the applicant provides its updated counting and 60-year projections for Transient 25, "Standby to SI hot leg injection check valve stroke test to standby (using the HPSI pump)." The applicant stated that the transient is conducted during refueling outages, and that the transient is not currently being counted because it was recently identified and added to the updated final safety analysis report Table 3.9-1. The applicant also stated that the transient will be counted when it is added to the scope of the transient cycle counting procedure.

Issue:
The applicant identified 16 occurrences of this transient for Units 1 and 3, and 17 occurrences for Unit 2, inclusive of December 31, 2005. The staff noted this transient is projected to occur 57 times through the end of the period of extended operation. The staff has noted a disconnect in the recording of occurrences for this transient going forward from January 1, 2006, and the time when the transient will be accounted in a future revision of the transient cycle counting procedure.

Request:
Clarify if the transient cycle counting procedure has been updated to include Transient 25 and if not, when the procedure will be updated. Explain how all occurrences of Transient 25 are considered.

RAI 4.3-10

Background:
In LRA Amendment 14, dated April 28, 2010, the applicant updated LRA Table 4.3-3. In this table, the applicant provides its updated counting and 60-year projections for Transient 79, "Reactor coolant system leak test."

Issue:
For Transient 79, "Reactor coolant system leak test," the applicant stated that its recent recount indicated that the transient occurred 5 times for Unit 1, 4 times for Unit 2, and 2 times for Unit 3 through the end of December 2005. It is not clear whether this transient represents the system leak test for the reactor coolant pressure boundary, mandated by ASME Code Section XI, Table IWB-2500-1, Examination Category B-P and 10 CFR 50.55a. The staff noted that this requires the applicant to pressurize its reactor coolant pressure boundary once every refueling outage to the normal operating pressure for the system and to perform a visual VT-2 examination of the system's components for evidence of reactor coolant leakage. The staff has noted that PVNGS has been operating for about 22 to 24 years of licensed operation. Thus, based on the time from initial operation, the staff estimates that the reactor coolant system leak test would have occurred approximately 14 to 16 times since initial operations of the units.

Request:
Clarify whether Transient 79 is different than the system leak test that is required by ASME Code Section XI. If the Transient 79 and the ASME Code Section XI system leak are different, clarify how the ASME Code Section XI system leak test is accounted for. If these two are not different, justify the occurrences of Transient 79, as described above, considering that it is required to perform this system leak test on a frequency of once every refueling outage.

RAI 4.3-11

Background:
On April 28 and May 27, 2010, the applicant submitted LRA Amendments 14 and 16, respectively. The amendments include an updated LRA Section 4.3.1.5, "Cycle Count Action Limits and Corrective Actions Subsection," which states the following:

> Since sufficient margin must be maintained to accommodate any design transient regardless of probability, the enhanced Metal Fatigue of Reactor Coolant Pressure Boundary Program (B3.1) corrective actions will be taken before the remaining number of allowable occurrences for any specified transient becomes less than one. Corrective actions will be required when the cycle count for any of the significant contributors to usage factor is projected to reach the action limit defined the enhanced Metal Fatigue of Reactor Coolant Pressure Boundary Program (B3.1) before the end of the next fuel cycle.

Issue:
The staff noted that, according to the second sentence of the quoted material, the applicant will require cycle counting corrective actions only for those design basis transients which the applicant considers to be significant contributors to fatigue usage.

Request:
Clarify the definition of the term "significant contributors to usage factor" and how this is associated with the corrective action limits in the enhanced Metal Fatigue of Reactor Coolant Pressure Boundary Program.

RAI 4.3-12

Background:
On LRA page 4.3-40 and 4.3-41, of Amendment 14, the applicant discusses its action limit for the CUF monitoring techniques and provides 7 corrective actions that may be used when a cumulative usage factor (CUF) action limit is reached.

Issue:
Corrective Action (1) on LRA page 4.3-40 states "Determine whether the scope of the enhanced fatigue management program must be enlarged to include additional effected reactor coolant pressure boundary locations." In regard to this corrective action, the staff noted that the applicant indicates that the corrective action is only applicable to reactor coolant pressure boundary components. However, in its review of LRA Section 4.3.2, the staff confirmed that the time limited aging analysis (TLAA) includes the CUF results for some ASME Code Class 2 components that were analyzed to ASME Section III CUF requirements for Code Class 1

components. As a result, the staff noted that the action in Corrective Action (1) may also be applicable to those ASME Code Class 2 components that were analyzed to ASME Section III CUF requirements for Code Class 1 components.

Request:
Clarify if the scope of Correction Action (1) on CUF monitoring includes all components with ASME Section III CUF calculations for Code Class 1 components and ASME Code Class 2 components that were analyzed to ASME Section III CUF requirements for Code Class 1 components. If the scope of Correction Action (1) does not include all components, justify why they are not within the scope.

RAI 4.3-13

Background:
The LRA includes Table 1 aging management review (AMR) items on management of cumulative fatigue damage in mechanical systems in LRA Tables 3.1.1 (reactor coolant system), 3.2.1 (engineered safety feature systems), 3.3.1 (auxiliary systems), and 3.4.1 (steam and power conversion systems). The applicant provided its further evaluation discussions on how the applicant would manage cumulative fatigue damage in components addressed in the applicable AMR items in LRA Sections 3.1.2.2.1, 3.2.2.2.1, 3.3.2.2.1, and 3.4.2.2.1.

LRA Sections 3.1.2.2.1 and 4.3.2.5 identifies that the CUFs analyses for the recirculating steam generator tubes do not need to be identified as a TLAA because the analyses are not being credited to manage either cumulative fatigue damage or cracking that could be induced in the tubes by a mechanism of fatigue. In LRA Amendment 16, the applicant makes the following statement to support its conclusion that the CUF calculations for the recirculating steam generator tubes do not need to be identified as TLAAs for the LRA:

> The design of the PVNGS steam generators includes a code fatigue analysis of the steam generator tubes, as indicated in Table 4.3-8. This analysis would be a TLAA if the safety determination depended upon it. However the design report indicates a zero fatigue usage factor, and a code fatigue analysis has historically not proved sufficient to support the safety determination for steam generator tubes, which depends on a separate tube inspection program.
>
> The various tube degradation mechanisms not anticipated in the original design have required stringent periodic inspection programs in order to ensure adequate steam generator tube integrity. The steam generator tubes are, in effect, (1) no longer qualified for a licensed design life (10 CFR 54.3(a) Criterion 3), and the (2) the fatigue analysis is therefore no longer the basis of the safety determination; in this case that the tubes will maintain their pressure boundary function between primary and secondary systems (Criterion 5).

Issue:
The staff noted that a CUF calculation of the replacement recirculating steam generator tubes was performed because the tubes are considered ASME Code Class 1 components that are designed to ASME Section III. The staff noted that the various degradation mechanisms discussed in the second paragraph of the quoted paragraph appear to make reference to steam generator tube cracking induced either by stress corrosion cracking (SCC) or any other

mechanisms. Cracking induced by these mechanisms has no relationship to cracking induced by high cycle or low cycle fatigue mechanisms. The staff noted that cracking of steam generator tubes has been induced either by intergranular SCC, primary water SCC, outside diameter SCC or intergranular attack mechanisms, and that the inservice inspections (ISI) of the tubes required by plant technical specifications have largely been implemented to detect cracking induced by these mechanisms. The staff also noted that these mechanisms do not have a relationship to the use of CUF calculations to qualify the tubes for cracking by a fatigue mechanism and do not constitute a valid basis for concluding the CUF values do not qualify the tubes for fatigue-induced cracking during their design life. It is not clear to the staff the basis for the CUF value of the recirculating steam generator tubes be equated to a value of zero.

In LRA Section 3.1.2.2.1, the applicant states that the pressurizer support skirts and attachment welds had been designed to ASME Section III requirements and had received an applicable ASME Section III CUF analysis. The staff determined that neither LRA Table 3.1.2-2 nor LRA Table 3.1.2-3, include any applicable line items on management of cumulative fatigue damage in the pressurizer support skirts and attachment welds, as aligned to any of the AMRs on cumulative fatigue damage.

The staff noted that the Summary Description in LRA Section 4.3.5 states that implicit fatigue analyses discussed in the section are applicable to all ASME Code Class 2 and 3 and ANSI B31.1 piping, piping components, and piping elements. The staff noted that it is not clear whether the LRA includes all corresponding AMR items for applicable ASME Code Class 2 and 3 or ANSI B31.1 piping, piping components, and piping elements scoped in for license renewal. The staff also noted that this includes those components in the Engineered Safety Features Systems (LRA Section 3.2), Auxiliary Systems (LRA Section 3.3) and the Steam and Power Conversion Systems (LRA Section 3.4).

Request:

1) Justify your basis for concluding that the CUF calculation for the replacement recirculating steam generator tubes do not need to be identified as a TLAA, when considering the use of SCC mechanisms and TS examinations does not appear to be a valid basis for concluding that the CUF calculations would not qualify the tubes for metal fatigue during the remainder of the licensed life of the tubes. Provide your basis for not including an applicable AMR line item for management of cumulative fatigue damage. Provide the basis that the recirculating steam generator tubes have a CUF value of zero.

2) Justify your basis for omitting applicable AMR items on cumulative fatigue damage of the pressurizer support skirts and pressurizer attachment weld components in either LRA Table 3.1.2-2 or LRA Table 3.1.2-3.

3) Clarify if the LRA includes all applicable AMR items with an aging effect of cumulative fatigue damage for those components scoped into license renewal. If not, justify why the LRA does not include all corresponding AMR items on cumulative fatigue damage for applicable ASME Code Class 2 and 3 or ANSI B31.1 piping, piping components, and piping elements scoped in for license renewal. Identify all component types that are within the scope of the implicit fatigue analyses for ASME Code Class 2 and 3 components and B31.1 components in LRA Section 4.3.5 and hence should be within the scope of applicable component-specific AMR items on cumulative fatigue damage.

RAI 4.3-14

Background:
LRA Section 4.3.2.1 provides a CUF value of 0.823 for the reactor pressure vessel (RPV) studs and a CUF value of 0.954 for the RPV lugs. LRA Section 4.3.2.1 also states that the RPV studs are the more limiting component because they will experience more severe stresses during each transient event, even though they are limited to a lower design limit on the number of allowable heatup and cooldown events.

Issue:
In updated LRA Table 4.3-4, in LRA Amendment 16, the applicant states that both of these component locations will be monitored using only cycle-based monitoring methods. The applicant's cycle-based monitoring methods do not include automatic periodic updates of CUF calculations. It is not clear to the staff if only cycle-based counting of the RPV studs will be performed, even though the RPV lugs have an existing CUF of 0.954.

Request:
Clarify whether or not the RPV stud/RPV lug limiting component discussion in LRA Section 4.3.2.1 is being made to clarify that cycle-based monitoring will be performed on the RPV studs. The staff requests the following additional actions if the discussion is being made to justify that cycle-based monitoring will only be performed in the RPV studs: (1) summarize the transients that were used for the CUF calculations for the RPV studs and RPV bottom head lugs, and for each of the transients analyzed, clarify the quantitative contribution to fatigue usage.

RAI 4.3-15

Background:
In LRA Amendment 16, the applicant updated LRA Section 4.3.2.8, Absence of Supplemental Fatigue Analysis TLAAs in Response to Bulletin 88-08 for Intermittent Thermal Cycles due to Thermal-Cycle Interface Valve Leaks and Similar Cyclic Phenomena.

Issue:
The U.S. Nuclear Regulatory Commission (NRC or the staff) Bulletin 88-08 referenced in LRA Section 4.3.2.8 recommended that a high cycle fatigue analysis be performed for the auxiliary pressurizer spray systems. LRA Section 4.3.2.8 states that Arizona Public Service (APS) performed a "supplemental bounding thermal gradient stress analysis to determine the effect of low cycle fatigue," and that the analysis did not evaluate the effects of high cycle fatigue on these lines, as recommended in Bulletin 88-08. The staff confirmed that the APS response to NRC Bulletin 88-08, dated October 3, 1988, did not commit to the performance of a high cycle fatigue analysis. It is not clear to the staff if the low-cycle fatigue analysis that was performed included any cycle based fatigue flaw growth or cycle based fracture mechanics analysis and thus, should be identified as a TLAA for the LRA. LRA Section 4.3.2.7, Subsection "Flow Stratification Thermal Gradient in the Auxiliary Spray Line and Tee" states that "the analysis of the thermal gradient demonstrated that the cumulative fatigue usage factor, including the effects of this thermal gradient, meets ASME Section III Subsection NB-3600 for a 40-year plant life." Based on this statement in LRA Section 4.3.2.7 it appears that this analysis meets the definition of a TLAA in accordance with 10 CFR 54.3(a).

Request:
Identify the low cycle fatigue analysis that is being referred to in LRA Sections 4.3.2.7 and 4.3.2.8 and clarify whether the low-cycle fatigue analysis on the auxiliary pressurizer spray systems included an applicable, implicit fatigue analysis, cycle-based fatigue flaw growth or cycle-based fracture mechanics analysis. Justify why the low-cycle fatigue analysis would not need to be identified as a TLAA if it is determined that analysis does include a cycle dependent analysis.

RAI 4.3-16

Background:
In LRA Amendment 16, the applicant amended LRA Section 4.3.2.10, "Class 1 Fatigue Analyses for Regenerative and Letdown Heat Exchangers."

Issue:
LRA Section 4.3.2.10 states that for the regenerative and letdown heat exchanger fatigue analyses were performed with transients specified in the Combustion Engineering (CE) general specification for System 80 plants. It further states that the original assessment that fatigue in the regenerative and letdown heat exchangers was bounded by the fatigue of the charging nozzle is still valid. However, LRA Section 4.3.2.10 does not identify the current design basis CUF values for the regenerative heat exchangers and letdown heat exchangers or which transients were evaluated in the System 80 CUF calculations for these heat exchangers.

Request:
Provide the current design basis CUF values for the regenerative heat exchangers and letdown heat exchangers and identify the transients that were evaluated in the CUF calculations of these heat exchangers, and the design basis limits for the transients analyzed in these calculations.

RAI 4.3-17

Background:
In LRA Amendment 16, the applicant amended Section 4.3.3, "Fatigue and Cycle-Based TLAAs of ASME III Subsection NG Reactor Pressure Vessel Internals." LRA Section 4.3.3 identifies that some of the reactor vessel internal (RVI) components were designed to the 1974 Edition of the ASME Code Section III, Subsection NG, or to more recent endorsed versions of the ASME Code Section III. The applicant identifies that the design codes required CUF calculations for these ASME Code Section III NG components. The applicant identifies that these analyses are TLAAs for the LRA.

Issue:
Materials Reliability Program Report MRP-227 identifies that the following CE RVI components are considered to be Code Class 1 components: (1) guide lugs and guide lug inserts and bolts, (2) fuel alignment pins, and (3) RVI components in the upper flange assembly. The assessment in LRA Section 4.3.3 does not identify which of the RVI components were designed to ASME Section III NG requirements and were required to have a CUF calculation.

Request:
Identify which RVI components are designed to ASME Section III NG requirements, and of these, which RVI components were required to have a CUF design calculation. For those RVI components that were required to have been analyzed with a CUF calculations, identify what the design basis CUF is for the given RVI component, and identify the transients that were analyzed along with their design basis limits on cycle occurrences. Justify the use of cycle-based monitoring if the existing design basis CUF value for any RVI component is high, for example in excess of 0.9

RAI 4.3-18

Background:
In LRA Amendment 16, the applicant amended LRA Section 4.3.5, "Assumed Thermal Cycle Count for Allowable Secondary Stress Range Reduction Factor in ANSI B31.1 and AMSE III Class 2 and 3 Piping." In LRA Section 4.3.5, the applicant identified all implicit fatigue analyses for ANSI B31.1 and ASME Class 2 and 3 piping components will remain valid for the period of extended operation except for the implicit fatigue analysis of reactor coolant system hot leg sampling lines and the recirculating steam generator downcomer and feedwater recirculation lines.

Issue:
The implicit fatigue analysis table provided for the RCS hot leg sampling lines includes a column, "Max. Calculated Stress Range per Eq. (11) (psi)." However, the column does not identify the source document for the referenced equation 11. Similarly, the implicit fatigue analysis table provided for the RSG DC and FW recirculation lines includes a column, "Max. Calculated Stress Range per Eq. (10) (psi)." However, the column does not identify the source document for the referenced equation 10.

In the assessment of the recirculating steam generator downcomer and feedwater recirculation lines, the applicant discussed two different analyses; the original implicit fatigue analysis and an updated pipe break analysis. LRA Section 4.3.5 does not clarify whether the pipe break analysis has a relationship to the original implicit fatigue analysis for these lines. It is also not clear whether both analyses are relied upon for the CLB or whether the pipe break analysis is a replacement for the original implicit fatigue analysis. It is not clear to the staff which of the analyses is the current analysis of record for the CLB and thus needs to be assessed as a TLAA for these lines.

Request:

a) Identify the source documents for the stated equation references.

b) Clarify which of the implicit fatigue analyses discussed in LRA Section 4.3.5 for the recirculating steam generator downcomer and feedwater recirculation lines is the analysis of record for these lines (i.e., the original analysis, the pipe break analysis, or both analyses).

July 21, 2010

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Sincerely,

/RA/
Lisa M. Regner, Sr. Project Manager
Projects Branch 2
Division of License Renewal
Office of Nuclear Reactor Regulation

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

Enclosure:
As stated

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Letter R. Edington from L. Regner dated July, 21, 2010

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