November 9, 1992

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

Mr. William F. Conway
Executive Vice President, Nuclear
Arizona Public Service Company
P.O. Box 53999
Phoenix, Arizona 85072-3999

Dear Mr. Conway:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION ON PALO VERDE NUCLEAR GENERATING STATION INDIVIDUAL PLANT EXAMINATION (IPE) SUBMITTAL (TAC NOS. M74445, M74446, AND M74447)

By letter dated April 28, 1992, you submitted the Palo Verde IPE results for NRC review. Based on our review of your submittal, we have determined that we need additional information to continue with our review. The enclosed list of questions identifies the information we need. Please review these questions so that we can schedule a conference call in about 30 days to discuss your responses. Following the call, a determination will be made as to whether we need a meeting to discuss any items further and which questions will need a written response. Our objective is to resolve these questions in 60 days.

Please contact us should you have any questions regarding this request.

Sincerely,

Original Signed By:
Charles M. Trammell, Senior Project Manager
Project Directorate V
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

Enclosure:
Questions on Palo Verde IPE submittal

cc w/enclosure:
See next page

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

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Enclosure:
Questions on Palo Verde IPE
submittal

cc w/enclosure:
See next page

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Arizona Public Service Company

Palo Verde

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ENCLOSURE

QUESTIONS ON PALO VERDE INDIVIDUAL PLANT EXAMINATION (IPE) SUBMITTAL

Palo Verde IPE Back-end Questions

1. On page 11-72, Item 11.8.2.6, you note that containment failure probabilities are relatively insensitive to variations in containment failure pressure. Discuss how the containment failure times change as a function of containment failure pressure.

2. You state on page 11-66 that "The probability of terminating the accident progression in-vessel is significant (over 48%)." This successful termination is strongly dependent on induced hot-leg failure and the ability to cool the damaged core once water injection has been successful. This is clearly pointed out in the sensitivity analyses in Subsections 11.8.2.1 and 11.8.2.3 (specifically, Case A1 and Case D1) where you consider "no induced RCS failures" and "no successful in-vessel cooling." Discuss the implications of these sensitivity analyses for the probability of early or late containment failure.

   Discuss the sources of uncertainties in induced hot-leg failure and in the in-vessel cooling of expected core configurations and the implications of these uncertainties for containment failure and radionuclide release.

3. With regard to PDS-1, in Subsection 11.5.1.8.1, page 11-31, it is stated that "[L]ong-term cooling of the debris in-vessel is not considered credible." However, as shown in Figure 11.A-2, a split fraction of 20 percent has been used for this event. Please explain the source of the 20 percent.

4. The conditional probabilities of the various containment failure modes given in Figure 11.5-12 add up to 97 percent instead of 100 percent. Please explain the disposition of the 3%.

5. Subsection 9.3, "Plant Modifications Resulting from IPE" makes no mention of having considered potential containment improvements to reduce severe accident vulnerabilities. In light of your findings, what were considered for potential containment improvements?

   Noting that the Palo Verde IPE has predicted a conditional probability for early containment failure that is an order of magnitude higher than that predicted by the Surry NUREG-1150 PRA, have you considered ways to reduce early containment failure? Do you predict any early containment failure from direct containment heating (DCH) or hydrogen burn? Please discuss as appropriate.

6. Has a C-Matrix been developed? That is, for each plant damage, state the fractional contributions to all of the containment failure or bypass modes. If so, please provide.

7. You state on page 11-68, paragraph 6, that the late failure releases begin to approach the early failure releases if the calculations are carried out far enough. Please explain.

8. Is the 169 psig value for containment failure the mean value (see page 11-23, Subsection 11.4.2) or the median value (see page 11-16, Subsection 11.3.3.5)? Please clarify the quantification.

9. Please provide a concise description of the independent containment isolation analysis referred to on page 11-15. Identify and discuss the contributors to containment isolation failure, i.e., isolation signal failure, valve failures (including containment purge values), degradation of valve seats etc., and the overall probability of isolation failure used in the probability risk assessment (PRA).

10. The sensitivity analyses (Sensitivity Calculations, Subsection 11.8) covered a broad range of phenomenological uncertainties associated with containment loading and failure modes. However, the phenomenological uncertainties themselves were barely discussed. Please provide a discussion of phenomenological uncertainties, i.e., the significant ones and the reasons.

11. NUREG-1335 (Section 2.2.2.6) recognized the importance of availability and survivability of systems and components during severe accidents. Discuss the treatment of systems/equipment exposed to post-accident environments (i.e., containment sprays, hydrogen mixing systems, etc.) and describe the IPE's treatment of equipment exposed to containment conditions during a degraded core accident and any important insights gleaned from the analysis.

12. Have you performed an analysis using plant-specific information on containment subcompartment configurations to address the likelihood of local hydrogen detonation and the effects of a local hydrogen detonation on containment integrity and equipment survivability? Please provide a concise discussion as to how the local detonation issue was addressed.

    Please provide the information requested in NUREG-1335 (Section 2.2.2.1), i.e., accurate but simple representations of the containment showing the Instrument Tunnel, Reactor Cavity compartment, Loop compartment(s), Annular compartment(s) and Upper compartment with specific identification of potential reactor release points and vent paths indicated. Estimates of compartment free volumes and vent path flow areas should also be provided. Address specifically how this information is used in your assessment of local hydrogen pocketing and detonation.

13. On page 11-67 you stated that "The alpha mode failure is not easily calculated with MAAP (though it can be expected to have a significant release term magnitude and must be characterized by similarity to one of the larger release categories)".

    Please explain how source terms were evaluated for sequences that involved alpha mode of containment failure.

14. NUREG-1335 (Section 2.2.2.4) requested that the licensee's submittal should include an assessment of penetration elastomer seal materials and

their response to prolonged high temperature. Describe the treatment of elastomer seals in your IPE, and any associated findings, results, and conclusions.

15. Please identify any important human actions related to the back-end analysis. Discuss how these actions were incorporated in the analysis, and the effects of any credit taken for human recovery actions on the IPE findings.

16. Please provide the following parameters characterizing radionuclide release for Table 11.7-8, which gives isotopic fractions of release:

    - Time of release
    - Duration of release

17. To facilitate our review, please discuss in detail at least one dominant case listed in Tables 11.6-2 through 11.6-6.

Palo Verde IPE Front-end Questions

1. On page 12-9 of Section 12.2.6 (Discussions on Turbine Room Flooding), there was no discussion of spray effects on the feedwater control valves. Unless these are submersible MOVs, they could lead to a plant trip if sprays were to cause them to close. Please discuss this issue.

2. The IPE submittal does not discuss the process used to screen out some of the initiating events listed in Table 4.1-1. Discuss the rationale for screening out initiating events from the preliminary list of initiating events.

3. What is the form of the data (i.e., median, mean, etc.) reported for initiating event frequencies and maintenance unavailabilities?

4. Please provide a concise discussion of the criteria used to define vulnerability. Include in the discussion a brief summary of how the IPE process and the IPE results were used to identify potential vulnerabilities due to human error and then to decide whether personnel performance enhancements are appropriate.

5. What are the bases for success criteria used in the event trees? That is, are they based on the FSAR, realistic calculations or expert judgement? If the success criteria are different from those of the FSAR, please provide a brief statement of the rationale for the difference.

6. Event tree top safety injection tanks ("SITs") in Figure 4.3-2 and "SIT COLD LEGS" in Figure 4.3-3 appear to model the same event. Please clarify.

7. What are the definitions of event outcomes S, CM, CMI, and CME used in Figures 4.3-1 through 4.3-10? Please provide the basis for distinguishing between CM, CML, and CME.

8. The Figure 4.3-6 event tree for feedwater line break appears to be inconsistent with the accident description provided. Please verify the error associated with this Figure and provide corrected documentation.

9. Provide a brief description of reactor power cutback system (RPCS) and its importance.

10. Are there any dependencies between Units 1, 2, and 3? If so, please specify and discuss their impact on the findings of the IPE. Please describe how the IPE treated multi-unit scenarios, i.e., initiating events that could affect multi-units simultaneously.

    Since the IPE submittal provides only one dependency matrix, please discuss whether the matrix is the same for all units.

    The operating data at Palo Verde indicated that Unit 3 seemed to have a disproportionately large number of operating events than the other two units. Please discuss whether this difference was considered in the IPE.

11. Although the initiating event frequency used in the IPE for Miscellaneous Trip is large, it is not considerably larger than assumed values in PRAs for other plants. The IPE reports that the contribution of Misc. Trip to core damage frequency (CDF), on the other hand, is large at Palo Verde, a finding inconsistent with trends exhibited by other PRAs. Please explain why Misc. Trip is a dominant contributor to CDF at Palo Verde.

12. Has the IPE considered the effects of a steam line break affecting the availability of auxiliary feedwater system and components? Please discuss your findings.

13. In view of your findings that implementing PORVs would reduce the total CDF from 9E-5 to 6.8E-5, describe your findings related to the implementation of the PORVs as one of the plant improvements.

14. Please describe the bases for the reactor coolant pump (RCP) seal model used in your analyses. What alternate seal injection systems for RCPs have you considered in the IPE process? Please discuss.

<u>Palo Verde IPE Human Reliability Analysis (HRA) Questions</u>

1. What HRA insights, if any, are gained from the IPE results regarding the enhancement of human reliability?

2. Briefly discuss how any dependencies which may exist between operator actions within individual accident sequences were addressed in the analysis.

3. Describe modifications made to the fire protection system test procedures to prevent or mitigate heating, ventilation, and air

conditioning (HVAC) isolation during testing.

4. If available, provide a listing which identifies the most significant operator actions and the percentage contribution of each to total core damage frequency.

5. Please provide a brief description of the involvement of the HRA specialist in the information assembly phase of the IPE.

6. Please provide additional information on the nature and extent of direct utility personnel participation in the human reliability analysis conducted as part of the IPE.

7. Briefly describe the approach taken in the IPE for considering the impact of human performance within the common cause analysis.

8. Provide a brief discussion of the screening process as it relates to the screening of human actions, including which classes of human actions were screened and what screening models/values were used.