50-445

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

March 15, 1996

Mr. C. Lance Terry
Group Vice President, Nuclear
TU Electric
Energy Plaza
1601 Bryan Street, 12th Floor
Dallas, TX 75201-3411

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) ON RISK-INFORMED INSERVICE TESTING (RI-IST) PILOT PLANT - COMANCHE PEAK STEAM ELECTRIC STATION UNITS 1, AND 2 (TAC NOS. M94165 AND M94166)

Dear Mr. Terry:

REFERENCES:

1. TU Electric (Comanche Peak Units 1 & 2) Request for Exemption from 10 CFR 50.55a(f)(4)(i) and (ii) for Inservice Testing (IST) Program (Testing Frequency), dated November 27, 1995.

2. Arizona Public Service (Palo Verde Generating Station) Request for Exemption from 10 CFR 50.55a(f)(4)(i) and (ii) for Inservice Testing (IST) Frequency, dated November 27, 1995.

3. Arizona Public Service (Palo Verde Generating Station) Request for Exemption from 10 CFR 50.55a(f)(4)(i) and (ii) for Inservice Testing (IST) Frequency, Supplement 1, dated December 20, 1995.

The NRC has been interested in supplementing deterministic techniques with probabilistic techniques to help define the scope, type, and frequency of inservice testing (IST). The development of risk-informed IST programs has the potential to optimize the use of NRC and industry resources without having an adverse effect on safety.

At the direction of the Chairman of the NRC, the staff is engaged in a 2-year effort to develop a regulatory guide and a Standard Review Plan (SRP) chapter that are sufficiently broad in scope to use in transitioning to more risk-informed regulatory decision making. These regulatory guidance documents will address general issues such as the role of the expert panel and the scope and quality of probabilistic risk assessment (PRA) necessary to support screening, detailed analysis, and risk ranking (such as the pilot-plant licensees did as part of the basis for their proposed risk-informed IST programs). In parallel with the development of broad regulatory guidance, the staff will develop a series of application-specific regulatory guides that are tied to specific regulations or program areas such as graded quality assurance, inservice testing of pumps and valves, inservice inspection, and technical specifications. As resources become available, application-specific SRP chapters corresponding to these application-specific regulatory guides will be developed.

DF01

On November 27, 1995, the staff received pilot plant exemption requests from TU Electric for Comanche Peak Units 1 and 2 (Reference 1) and from Arizona Public Service for Palo Verde Nuclear Generating Station Units 1, 2, and 3 (Reference 2, as augmented by Reference 3) to implement risk-informed inservice testing programs in lieu of inservice testing programs constructed pursuant to Section XI of the ASME Code.

The staff's review of the pilot-plant licensee exemption requests is proceeding in parallel with the development of the risk-informed regulatory guides and SRP sections. As staff positions are more firmly established on the scope, level of detail, and quality of PRA necessary to support risk-ranking, this information will be conveyed to the pilot-plant licensees in the form of additional RAIs if necessary. We expect that development of the risk-informed IST regulatory guide and the SRP chapter and the staff's review of the pilot plant submittals will be an iterative process.

The staff has reviewed the licensees' exemption requests and proposes that the attached comments and requests for additional information (RAIs) be forwarded to the pilot-plant licensees. Key issues raised by the exemption requests and discussed in these comments and RAIs include the following:

- The NRC anticipates issuing temporary exemptions (or authorizing an alternative to the existing Code testing requirements on an interim basis) to the pilot-plant licensees. After completing the regulatory guidance related to risk-informed IST programs and reviewing the industry guidelines being developed by the Nuclear Energy Institute (NEI), the staff will reevaluate the exemption. The NRC plans on revising 10 CFR 50.55a before the risk-informed IST option is made available to a significant number of additional licensees.

- The technical basis for test interval extensions should be based on component performance, operational experience, and risk insights (i.e., not on PRA alone), and there should be a performance-based feedback mechanism to ensure that if a particular component's test interval is extended too far it gets expeditiously identified and corrected.

- The staff will need to work with the pilot-plant licensees to better define the processes and decision criteria used by the licensees to risk-rank components and to define the appropriate test frequency for components. The staff needs more than a general description of the process and tabulated results to adequately evaluate the licensee's proposed testing and to help develop risk-informed regulatory guides and SRP sections.

- The pilot-plant licensees have to demonstrate that adequate review of the plant's PRA has been performed and that the level of detail and scope of the PRA is sufficient for the IST risk-ranking application. This review could consist of an independent external peer review and a documented comparison of the PRA input and data, modeling, assumptions, and results with those from PRAs of similar plants.

Although separate comments and RAIs are attached for each pilot-plant licensee, the staff has provided each licensee with both sets of comments and RAIs. The licensees have collaborated with each other and with NEI in developing their applications. While the two sets of comments and RAIs may differ, the staff's intention is to be consistent on all of the technical and policy issues. Any perceived differences identified by the licensees should be brought to the staff's attention as soon as possible for clarification.

The staff would like to meet with each pilot-plant licensee within a few weeks after transmittal of the comments and questions to the licensees and before the licensees prepare written responses to these comments and questions. Based on information that the licensees provide to the staff at these public meetings, the staff will, to the extent practicable, identify those questions and comments for which written responses are not expected of the licensees.

The staff appreciates the licensees' willingness to work with the NRC to help define methods and criteria necessary to produce acceptable risk-informed IST programs at the pilot-plant sites. The staff's interactions with the pilot-plant licensees will be instrumental in helping the staff develop regulatory guidance that can also be used by other licensees to produce safe and more cost-effective IST programs.

The requirements affect nine or fewer respondents and, therefore, are not subject to the Office of Management and Budget review under P.L. 96-511. If you have any questions, please contact me at 301-415-1330.

Sincerely,

Robert A. Gramm For

Timothy J. Polich, Project Manager
Project Directorate IV-1
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket Nos. 50-445 and 50-446

Enclosures: 1. Comanche Peak Request for Additional Information
2. Palo Verde Request for Additional Information

cc w/encls: See next page

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Original signed by:
Timothy J. Polich, Project Manager
Project Directorate IV-1
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Mr. C. Lance Terry
TU Electric Company

Comanche Peak, Units 1 and 2

cc:

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
P. O. Box 1029
Granbury, TX 76048

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011

Mrs. Juanita Ellis, President
Citizens Association for Sound Energy
1426 South Polk
Dallas, TX 75224

Mr. Roger D. Walker, Manager
Regulatory Affairs for Nuclear
Engineering Organization
Texas Utilities Electric Company
1601 Bryan Street, 12th Floor
Dallas, TX 75201-3411

Texas Utilities Electric Company
c/o Bethesda Licensing
3 Metro Center, Suite 610
Bethesda, MD 20814

George L. Edgar, Esq.
Morgan, Lewis & Bockius
1800 M Street, N.W.
Washington, DC 20036-5869

Honorable Dale McPherson
County Judge
P. O. Box 851
Glen Rose, TX 76043

Office of the Governor
ATTN: Susan Rieff, Director
Environmental Policy
P. O. Box 12428
Austin, TX 78711

Arthur C. Tate, Director
Division of Compliance & Inspection
Bureau of Radiation Control
Texas Department of Health
1100 West 49th Street
Austin, TX 78756-3189

COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2

DOCKET NOS. 50-445, AND 50-446

REQUEST FOR ADDITIONAL INFORMATION REGARDING

RISK-INFORMED INSERVICE TESTING (RI-IST) PILOT PLANT

The following are the initial questions and comments that have been developed by several NRC staff reviewers who have been reviewing the Comanche Peak Exemption request. We have attempted to remove redundant questions from the different reviewers and to order the questions generally according to the order of the material presented in the submittal. There may be some redundancy remaining. In the responses to these questions, it is acceptable to refer to other questions for parts of answers or to other documents when that would be appropriate.

I. GENERAL QUESTIONS INCLUDING THOSE RELATED TO THE CPSES TRANSMITTAL LETTER

G-1 (page 1 transmittal letter)
In the second paragraph of this page, it is stated that the methodology described in this document is consistent with the EPRI/NEI PSA Applications Guide generally. Please identify the areas that you consider significant where you deviated from the guidance in the PSA Guide and your reasons for doing so.

G-2 (page 1 transmittal letter)
It is indicated that the proposed risk-based process utilized the CPSES IPE and IPEEE. Were there any significant changes that needed to be made to the IPE and IPEEE PRA models? If so, please identify each change made and indicate its perceived importance with regard to this application.

G-3
Are there any plans to perform partial-stroke testing of any check valves classified as LSSCs during the deferred testing period? (see E5-9)

II. QUESTIONS ON ENCLOSURE 1 - EXEMPTION REQUEST

E1-1
The exemption request (pages 2 of 4 and 4 of 4) states that:

> The Risk-Based IST Program Description may be revised without prior NRC approval, provided the changes do not have an adverse impact on plant safety.
>
> This provision is similar to the change process for other Licensing Basis Documents such as the Security Plan. The regulations for the Security Plan allow changes without prior approval provided there is no unreviewed safety question or the effectiveness of the Plan is not reduced.

More specific criteria need to be developed for determining if a change (i.e., to the NRC-approved risk-informed inservice testing (RI-IST) program) will have an adverse impact on plant safety. In the case of the Security Plan, the NRC relies on the criteria contained in 10 CFR 50.59 to determine if the proposed change involves an unreviewed safety question. These criteria may not be appropriate for this application.

a. Please list and describe the types of revisions to the IST program that would be made without prior NRC approval if the exemption request is granted.

b. Also, in cases when NRC approval is not required, what criteria will be used to determine when the NRC will, however, be notified of the revisions?

E1-2
The exemption request (page 2 of 4) states that:

> Compliance with this exemption request constitutes compliance with 10 CFR 50.55a and the existing CPSES Technical Specifications.

Staff approval of an exemption from the requirements of 10 CFR 50.55a (f) does not relieve the licensee of its responsibility to comply with Technical Specifications (TS).

E1-3
The exemption request (page 3 of 4) states that:

> Even though the components [that are identified as being more safety significant] are outside the Code class boundary, they will be tested commensurate with their safety significance. The expert panel will determine the appropriate compensatory measures for the safety function.

The Risk-Based IST Program Description needs to describe how the expert panel will go about doing this. (see PRA- 7 & 8)

<u>E1-4</u>
The exemption request (page 3 of 4) states that:

> Components in the current ASME Section XI IST Program which are determined to be MSSCs will continue to be tested in accordance with the current Program.

The licensee should describe its method for determining the test frequencies of both the LSSCs and MSSCs. If the test frequency for the MSSCs was based solely on the Code test frequency, and not through a risk analysis, discuss why this is acceptable.

<u>E1-5</u>
The exemption request (page 3 of 4) states that:

> LSSC will also be tested in accordance with the ASME Section XI IST Program, except that the test frequency will initially be extended to once every 6 Years.

The test interval for LSSC must be supported by performance data such that the licensee can reasonably expect to find that the component is functional when the inservice test is performed. A risk analysis should be supported by performance data for the proposed test interval, i.e., the PRA should be supplemented by deterministic methods, such as performance history and operating experience, to evaluate the acceptability of the proposed test frequency. Furthermore, there should be a performance based feedback mechanism in place to ensure that any ineffective test strategies that get implemented are promptly detected and revised. Please discuss.

<u>E1-6</u>
The exemption request (page 4 of 4) states that:

> The risk-based process will assure that a defense-in-depth philosophy is maintained.

The licensee should specifically describe how the process will assure that defense-in-depth will be maintained. (see <u>PRA-5 & 6</u>)

<u>E1-7</u>
The exemption request (page 4 of 4) states that:

> There are safety enhancements obtained by focusing resources on MSSCs and reducing the testing frequency on LSSCs.

Please describe how the licensee's proposed risk-based IST process focuses resources on the MSSCs. (see <u>E1-4</u> and <u>E3-1 & 3</u>)

<u>E1-8</u>
Enclosure 1, page 4 of 4: "As a living process, components will be reassessed periodically to reflect changes in plant configuration..." Please define "periodically." (see <u>E2-5</u>)

III. QUESTIONS ON ENCLOSURE 2 - RISK-BASED IST PROGRAM DESCRIPTION

E2-1
The Risk-Based IST Program Description (page 1 of 2) states that:

> The proposed exemption is a risk-based process to determine the safety significance and testing frequencies [emphasis added] of components in the ASME Section XI IST Program ...

This seems somewhat misleading in that the risk-based process does not appear to adequately determine the appropriate test frequency for the LSSCs. It evaluates the risk significance of extended test intervals based on certain assumptions but it does not appear to determine the optimal test interval based on performance data, component unavailability, and risk insights. (see E1-5)

E2-2
The Risk-Based IST process proposed by the licensee (page 2 of 2) will review the test strategy of MSSCs not in the ASME Section XI Program to ensure that testing is performed commensurate with their safety significance. How will the licensee determine the test strategy for these components? Would it be beneficial to do a similar evaluation for MSSC in the ASME Section XI program? (see E4-16).

E2-3
The Risk-Based IST Program Description (page 1 of 2) states that:

> Extended test frequencies will be phased in over the initial 6 year period in order to take advantage of the benefits that can be obtained through sampling techniques. Groups of components will be established using sampling based on guidance provided in NUREG 1482. Components in each group will be tested during each fuel cycle so that each component is tested at least once every 6 years.

The NRC will need to review the actual component groupings, the detailed grouping criteria, and sample expansion criteria in order to evaluate the adequacy of this phased-in approach. Also, please describe the implementation schedule to achieve deferred testing on a staggered basis.

E2-4
The Risk-Based IST Program Description (page 2 of 2) states that:

> When an LSSC on the extended test frequency fails to meet established test criteria, corrective actions will be taken in accordance with the CPSES corrective action program. This corrective action will include an evaluation of the need to test the remaining components in the group.

Describe the CPSES corrective action program. What criteria would be used to initiate testing of the remaining LSSC components in that group? The corrective action should explicitly include consideration of the need for revising the test frequency.

E2-5
Describe the periodic reassessment (page 2 of 2) that would be performed on the PRA. What events or findings would be required to initiate an update to the PRA? The periodic reassessment section of the Risk-Based IST Program Description should be revised to clarify that both the component importance ranking and the test frequency will be periodically reassessed. (see E1-8)

E2-6
If it is to be used, describe how the ASME Code Case OMN-1, "Alternative Rules for Preservice and IST of Certain Electric Motor Operated Valves in LWR Power Plants," may be used in conjunction with the risk-informed IST program.

IV. QUESTIONS ON ENCLOSURE 3 - RISK RANKING DETERMINATION STUDY SUMMARY REPORT

E3-1
The Background section (i.e., Section 1.0) states that "changes that negligibly reduce plant safety should not be ruled out, especially if such changes can lead to significant plant performance improvements in other areas." The licensee should be more specific about what these other "significant plant performance improvements" are. How are the resource savings being "focused" on the MSSCs? (see E1-7 and E3-3)

E3-2
The Project Scope and Objectives section (i.e., Section 2.0) states that "The ASME O&M Committee is reviewing the more safety significant components to ensure that the appropriate tests are identified and performed on those components for their respective failure modes." The licensee should clarify the relevance of this activity to their exemption request (i.e., does the licensee anticipate incorporating revised ASME Code test strategies into their risk-informed IST program?). Please give us any updated information about the schedule for this activity and how the licensee plans to evaluate the potential value of utilizing this information in its IST program.

E3-3
In the Project Scope and Objectives section (i.e., Section 2.0) under Direct Safety Enhancements, it states that:

> Greater attention and resources devoted to the high priority IST components could translate into many direct safety enhancements. First, this group of components could be subjected to, where practical and meaningful, more frequent periodic tests than the lower priority groups. The timeliness of any problem identification and resolution would be improved. Second, requirements associated with the high priority group of IST components are expected to be more rigorous and demanding in nature than for other groups. These requirements provide added assurance that any problems that may impact the functionality of the components will be identified and resolved.

It is unclear how the "improvement" and "added assurance" will be realized. (see E1-4 & 7, E2-2 and E3-1)

E3-4
The Project Approach section (i.e., Section 3.0) states that "the strength of this risk based IST program and the integrity of its results lie in the robustness of the methodology and in the work of the Steering Committee and expert panel." Therefore, the specific activities of the Steering Committee and expert panel need to be documented along with the basis (i.e., including decision criteria) used in arriving at their conclusions. (see PRA-7)

E3-5
In the Methodology section (i.e., Section 3.1), the licensee states:

> If RAW was significant, the component was considered by the expert panel for placement in the high category. If the panel decided the component could be ranked low, an additional requirement was imposed before a component could be classified as "less risk significant." A compensatory measure was required to be selected by the expert panel to limit degradations in reliability.

There are 32 IST components that had RAW > 2 that were categorized as less safety significant (e.g., 1-HV-2333A, 1-HV-2334A, 1-HV-2335A, 1-HV-2336A, 1CC-0060, 1CC-0061, 1CC-0621, 1CC-0062, 1CC-0657, 1CC-0694, 1CC-0713, 1-HV-4699, 1-HV-4700, 1CC-1075, 1CC-1077, 1CC-1078). How did component reliability and redundancy play into the expert panel's ranking decisions and what criteria did they use? Please describe the compensatory measures for each component and justify how each measure provides equivalent functional benefit compared with ranking the component in the high category.

E3-6
In the discussion of sensitivity studies (i.e., Section 3.3) conducted to test the completeness of the models, assumptions, and input data, it states:

> Less risk significant components were assumed to be influenced two at a time. Four such components were identified which, together with other components, offered the potential of becoming more risk significant. Appropriate compensatory actions designed to limit reliability degradations were imposed on these components.

What were these components and what were the compensatory actions imposed on them? What were the results of the sensitivity study conducted to evaluate whether changes to inservice testing offered the potential for common-cause-like degradations in components of different systems?

E3-7
In discussing the cumulative effects of test interval changes (i.e., Section 3.4), the licensee states that "calculations indicate that the test intervals could be increased from quarterly to six years or more with acceptable increases in risk." What is the licensee's basis for determining an acceptable level of risk? In addition, a linear extrapolation of the component unavailability may not be justified because it does not take into consideration potentially age-dependent failure rates. (see PRA-24)

E3-8
The staff would like a copy of the CPSES procedures (see Section 3.6) or program documents that "provide assurance that failures of IST components will be promptly identified and addressed and modifications to the inservice testing program (e.g., changes to the surveillance intervals) are made in a timely manner."

E3-9
The staff would like to review the detailed system notebooks, the human reliability analysis, and the results of parts of the independent IPE review activities during a site visit. (see PRA-1)

E3-10
In the Summary of Expert Panel Process (i.e., Section 4.1), it states that "[i]n more than one case, a component's ranking was increased to high because inservice testing helped prevent entry into a limiting condition for operation (LCO)." What are the specific components involved? How did the expert panel identify them?

E3-11
Based on the Summary of Expert Panel Process (i.e., Section 4.1), it is not clear that the expert panel was sufficiently aware of the assumptions and limitations associated with the IPE (e.g., completeness issues) to adequately compensate for them. It also was not clear how the expert panel dealt with specific concerns that the IPE did not model (e.g., fires, tornadoes, shutdown risk, seismic concerns, etc.). What guidance and decision criteria were used by the panel for each of these issues? (see E3-16 and PRA Section D)

E3-12
What criteria were used to evaluate components that were not modeled in the CPSES IPE (i.e., other than components whose failure might affect redundant trains and were subsequently ranked high)?

E3-13
Figure 3-1 of Enclosure 3 provides a decision criterion for risk importance measures. This criterion is not consistent with that discussed in the summary and conclusions in Section 4 or with the Summary of risk ranking results provided in Table 4-1. Specifically, a "medium" category is introduced in the conclusions, and in Table 4-1 "high" F-V refers to FV>0.01 not FV>0.001 as shown in Figure 3-1. Although, in final IST ranking, all "medium" F-V components were ultimately ranked high, the introduction of a medium category is somewhat confusing. Please clarify.

Questions E3-14 through E3-16 relate to Table 4-1 of Enclosure 3

E3-14
There should be a detailed explanation as to why components changed from one category to another as a result of the expert panel process (e.g., a detailed evaluation sheet for each component). For example,

- DG fuel oil transfer pumps with high F-V and RAW were ranked LSSC.
- SI accumulator upstream injection check valves were not modeled but were ranked MSSC.
- Containment spray pumps were not modeled but were ranked MSSC.
- Boric acid transfer pumps were not modeled but were ranked MSSC.
- Bonnet relief valves for CIVs 1-8811A/B were not modeled but were ranked MSSC.
- SW vent paths for water hammer protection were not modeled but were ranked MSSC.
- CR A/C accumulator instrument air supply upstream and downstream check valves were not modeled but were ranked MSSC.
- SIP/CCP suction header cross-tie isolation valve was modeled but was ranked MSSC.

E3-15
In Tables 4-1 and 5-1, what is the difference between N/A and None in the columns (e.g., initial ranking column)? What does it mean when a component, such as the SI pump suction valves, have a F-V and RAW calculated but the initial ranking is listed as "None?" Why does it say "low" for certain ranking changes due to expert panel review (i.e., as opposed to increased, decreased, or no change)?

E3-16
How did the expert panel deal with IPEEE Fire & Tornado FV Ranking, Outage Risk Ranking, LERF Ranking, Seismic Risk Ranking, CDF Ranking Changes w/o CCF? What decision criteria were used? Was there an orderly procedure to address each of these issues? How did the expert panel deal with other limitations of the PRA (e.g., truncation limits, generic vs. plant specific failure rates and unavailability information)? (see E3-11 and PRA Section D)

V. QUESTIONS ON ENCLOSURE 4 - RISK RANKING DETERMINATION STUDY

E4-1
The costs identified in the Risk Ranking Determination Study (pp 1-2/3) and in the Summary Report (pp. 1-2/3) inappropriately assume that design basis testing (i.e., as described in the letter from James E. Richardson, NRC, to Forrest T. Rhodes, ASME, dated 9/9/91) is or will be required for all components currently in the plant IST program.

E4-2
On page 2-1 of the licensee's submittal it is stated that the scope of this project is to optimize the safety benefits in assuring pump and valve performance. How will this be done if the only substantive change to the IST program is to extend the test interval for the LSSC components (other than adding a few MSSC not in the current IST program and taking compensatory measures for components with RAW > 2 determined to be LSSC)? If component wear out and operator burden are the reasons, what data support this claim?

E4-3
The Indirect Safety Enhancement section (p. 2-2) states that "these analyses identify important scenarios that provide information with regard to the operational demand that may be placed on a given component. Such information is valuable because it relates the performance of the IST component to the broader context of plant safety." How is this information used to adjust the IST program?

E4-4
On page 3-2 of the licensee's submittal it states that "it was important to ensure that a reduction in test intervals [presumably "frequency" as opposed to "interval"] did not allow unintended consequences, i.e., a compromise in safety resulting from a degradation in reliability." How does the licensee plan to monitor LSSC performance or reliability to ensure that it will not degrade (i.e., including LSSC with RAW < 2)? Please discuss why the current Code test methods are acceptable for components whose test interval will be extended. Could extending the test interval make different failure causes (e.g., age dependent failure mechanism) more important to detect? Will the current Code test detect these failures or impending failures?

E4-5
On page 3-5 of the licensee's submittal it states that "there was a systematic review of components that were not explicitly modeled in the IPE." How was this review conducted? Please identify the components that were reviewed.

E4-6
In the first paragraph on page 4-3, a statement was made that the RAW provides a measure of functional importance that is independent of the reliability of the component. Please explain.

E4-7
On page 4-4 of the licensee's submittal it states that "if the assessment of common-cause events results in a group of components having a significant impact on CDF, then those components should be added to the high importance category as well." What components were added to the high category based on common cause failure (CCF)?

E4-8
Table 4.1-3 identifies 20 components that were more risk significant for fire [and tornado] than they were in the IPE. The section on Fires and Tornadoes goes on to state that:

> The expert panel confirmed that the basis for the ranking and the corresponding risk insights were reasonable (i.e., the risk importance of these components increased because the direct effects of the external event affected the ability of components in the opposite train to perform their intended function).

How does a fire in one train affect the ability of a component in the opposite train to perform its intended function (i.e., as opposed to increase the importance of the component in the opposite train)?

E4-9
On page 4-13 of the licensee's submittal it states that "[t]he experience data (Ref. 9, Appendix A) shows that some pumps wear out faster after earthquakes, possibly because of mis-alignment; however, given the relatively short mission time, this is not an important consideration." What is the basis for this conclusion?

E4-10
In the Outage Risk Importance section (p. 4-15) it states that "components in key trains were ranked into three categories using a qualitative set of rules." The rules are then summarized on pages 4-18 and 4-19. Why was outage risk importance considerations limited to components included in the IPE?

E4-11
On page 4-17 of the licensee's submittal it states that "[t]here can be times when almost any component can become more risk significant depending on the outage scenario." It is not clear if the licensee has a rigorous process for dealing with dynamic risk as it relates to risk ranking for IST purposes. Please discuss. (see PRA-21)

E4-12
It is not clear how each of the seven safety functions identified on page 4-15 as being important to shutdown risk are addressed in the discussion of outage risk. This section (i.e., Section 4.1.3) discusses specific safety functions and system configurations but it is not clear from reading the licensee's submittal what methodology was used by the expert panel in order to ensure comprehensive and repeatable results (e.g., the expert panel decided to require compensatory measures if certain valves [important to LERF or

containment isolation] were not otherwise ranked high). It was not clear from reading the licensee's submittal how the expert panel reconciled Category 1/Category 2/Category 3 ranking components important to outage risk with High/Medium/Low rankings for components associated with back-end considerations and with MSSC/LSSC based on direct IPE/PRA results (i.e., a given F-V or RAW value).

E4-13
Table 4.1-5 and the CIV write-up on page 4-27 are inconsistent (i.e., 1-8153 vs 1-8152).

E4-14
As part of a site visit, the staff would like to discuss and review more detailed documentation of the expert panel's deliberations and meeting minutes (not just the summary of the results as presented in Tables 4.4-1 and 4.4-2) in order to understand the basis for ranking unmodeled components. For example, why were the unmodeled SG safety valves categorized low by the expert panel? On page 4-33 of the licensee's submittal it states that the expert panel's evaluation of unmodeled components were documented in two forms. What documentation, other than the expert panel meeting minutes, is available? (see PRA-7)

E4-15
In the High-Risk Components section (i.e., § 4.1.6) it states that:

> An evaluation of such components was done as part of this study. This involved careful evaluation of the IPE modeling assumptions and conservatisms, component failure modes, operator action, recoveries and any other effects that could substantiate the ranking. These were reviewed by the expert panel.

How was this careful evaluation and review conducted? What methodology was used and how was it documented (the detailed process that led to the reported results)? (see E4-30 and PRA7)

E4-16
Table 4.4-2a states that for instrument air relief valves not protected by check valves that can depressurize the common header:

> An evaluation will be performed to determine the appropriate equivalent IST compensatory actions for the IPE failure modes.

The staff needs to understand the evaluation and know the alternative IST proposed before it can approve the exemption request. Why is testing for the IPE failure modes appropriate for MSSC not in the current IST program and not for the other MSSC (i.e., components that are already in the current IST program)? (see E2-2)

E4-17
The CST to AFW pump isolation valves and the PMP/CCP suction cross-tie valve are shown (in Table 4.4-2a, High Ranked IPE Components Not in the Current IST Program) to be MSSC by the IPE and expert panel, but the Compensatory Actions and Comments sections state:

> No applicable inservice test for normally open manual valves without remote position indication.
>
> Current plant programs are adequate to maintain a low failure probability. Programs include the quarterly IST pump test which will verify position is open and either the locked valve program or position surveillances every 30 days per technical specifications. The IPE did not credit operator recovery by opening the valve if it was left closed.

It is not clear that the IPE failure mode that caused these valves to be MSSC are addressed by the proposed test strategy. While the quarterly pump test may be adequate to test the suction valve, the risk-based IST program should document the testing of each MSSC.

E4-18
Table 4.4-2a, High Ranked IPE Components Not in the IST Program, should identify the proposed compensatory actions (i.e., not TBD).

E4-19
There does not seem to be a one-to-one map between the completeness issues described in Section 4.2 and the subsequent sub-sections (e.g., to compensate for PRA limitations the expert panel is required to identify components with operational concerns, but this issue does not seem to have a companion sub-section). Please discuss.

E4-20
The sensitivity studies described in Section 4.2.5 do not appear to adequately explore whether components could easily change from one category to another as a function of:

a. failure rates which could be age-dependent,

b. component unavailability assumptions which tend to vary with service condition, and

c. small variations of the decision criteria [i.e., F-V and RAW thresholds].

(see PRA-15 through 22)

E4-21
Truncation (Table 4.2-1) of all valves in the containment spray system (i.e., because they are "not required for CDF and not significant for LER") may not be appropriate because it removes defense-in-depth and could affect containment failure probability and health effects. Please discuss. (see PRA-5 & 6)

E4-22
On page 4-42 it states that "Safety Chilled Water is a system that meets the qualitative definition of initiator importance but not the quantitative one. To be conservative, this system was added to the list of important initiators." This does not appear to be reflected in Table 4.2-2 and Table 4-1 (e.g., pumps appear to have a marginal to high F-V, valves are all ranked low). Is this "[b]ecause these three systems cumulatively contribute less than 6 percent to total CDF, the small change in initiating event frequency (due to the relatively small number of components affected) ensures that the cumulative effects on the CDF and LERF due to IST test interval changes [are] insignificant?"

E4-23
In the sensitivity study section, it states that the CCW, SI, and CVCS pump discharge check valves (p. 4-47) all had elevated importance for fire and large early releases and that "the sensitivity study seems to confirm a pattern of underlying importance for selected components in these systems despite the fact that they did not meet the original importance thresholds." Why is it then that the CCP and CCW pump discharge check valves are not ranked as high in Table 4-1?

E4-24
Section 4.3 states that a 66 percent increase in CDF and a 70 percent increase in LERF is "much less than any reasonable acceptance criteria for classifying something as safety neutral." The staff does not agree with the licensee that increases less than a factor of 2 are necessarily safety neutral just because these increases are within the uncertaintity bounds of the original estimate.

E4-25
The licensee states (Section 4.3, page 4-53) that the total risk may in fact decrease because high-ranked valves not in the current IST program are being considered for increased testing. The only "additional" testing identified in the licensee's exemption request were for the CST to AFW pump isolation valves and the PMP/CCP suction cross-tie valve which will be tested by having the associated pump quarterly IST and either locked valve program or 30-day TS surveillance. It appears that no additional testing (other than that currently being done) has been proposed.

E4-26
Page 4-63: Was the unmodeled valve that the expert panel moved to the high category (i.e., because it might degrade the performance of more than one pump) the RHR pump mini-flow valve? If so, Table 4-1 seems to suggest that it was modeled.

E4-27
The expert panel section (i.e., Section 4.4, page 4-65) states that:

> Evaluations were performed to determine how to use existing in-service testing techniques most effectively to address the more safety significant failure modes in the IPE. The following three questions were normally asked for these evaluations:
>
> - Does in-service testing apply to the failure modes that are risk significant?
> - What testing is currently being done?
> - Does ranking justify an improvement in testing to an IST-type testing program?
>
> For components or IST functions not modeled in the IPE, the same systematic approach was taken as for modeled components.

How was this evaluation normally conducted? Was it documented (e.g., component-by-component)? (see E4-30 and PRA-7)

E4-28
HV-4699 & HV-4700 and HV-4696 & HV-4709 were ranked LSSC and had RAW > 2; however, the expert panel proposed no compensatory actions. Why? While current IST may not check the IPE failure mode, some other test or compensatory action may be appropriate.

E4-29
The compensatory actions described by the licensee (i.e., in Tables 4.4-1, 4.4-2, and 4.4-2a) do not seem to explicitly check for degradation in valve reliability and nothing new is proposed (e.g., the valve gets cycled for some other maintenance or testing activity, or degradation/failure would be detected by an alarm). Please discuss. (see E3-5)

E4-30
Section 8, "Appendices" of the licensee's submittal states that "Comanche Peak Steam Electric Station Risk-Based In-Service Testing Expert Panel Guidance Document" will be provided later. The substance of what the expert panel considered and how they resolved issues needs to be reviewed by the staff. Please include the schedule for providing this document. (see PRA-7)

E4-31
The positive displacement charging pump is not listed on Table 4-1 along with the other charging pumps. Was the positive displacement charging pump modeled in the CPSES PRA? What was the result of the risk-ranking for this pump? What testing strategy is proposed for this pump?

E4-32
Page 4-42 states that:

> Safety Chilled Water is a system that meets the qualitative definition of initiator importance but not the quantitative one. To be conservative, this system was added to the list of important initiators.

Why are the safety chiller CCW return valves (1-PV-4552 & 1-PV-4553) ranked low?

E4-33
In the summary and conclusions (section 5), references were made to a "decrease in plant risk" and "safety neutral." Please provide a basis for these assertions or quantify the risk decrease.

VI. QUESTIONS ON ENCLOSURE 5 - IMPLEMENTATION RESULTS AND SYSTEM DRAWINGS

E5-1
DWG M1-0257: Why are boric acid transfer pumps TCX-CSAPBA-01 and 02 not ranked as being more safety significant when boric acid transfer pumps TBX-CSAPBA-01 and 02 are MSSC?

E5-2
a. Why is 1-8969A/B ranked low when 1-8924 and 1-8804 are ranked high (DWG M1-0261)?

b. Why is 1-8958 ranked low when 1-8812A/B are ranked high (DWG M1-0263 Sheet 5 of 5)?

c. Why are 1-8730A/B ranked low when 1-HCV-0606/0607 and 1-8716A/B are ranked high (DWG M1-0260)?

d. Why are 1SI-8919A/B ranked low when 1-8814A/B are ranked high (DWG M1-0263 Sheet 4 of 5)?

e. Why are valves 1-8922A/B ranked LSSC when the SI pumps and other valves in the injection flowpaths to the cold legs are ranked MSSC (DWG M1-0263 Sheet 4 of 5)?

f. Why are the high head SI pump cross-tie valves (i.e., 1-8821A/B) ranked LSSC (DWG M1-0263 Sheet 4 of 5) when the low head SI (i.e., RHR pump) cross-tie valves (i.e., 1-8716A/B) (DWG M1-0260) are ranked MSSC?

g. Why would not 1-HV-4776 and 1-HV-4777 be MSSC if the CS pumps are MSSC (DWG M1-0232 Sheet 1 of 2)? Why would 1CT-0013/0042/0065/0094 and 1CT-0142/0145 check valves in this same flow path, not also be ranked high?

h. Why are valves in the auxiliary feedwater (AFW) flowpath ranked low when the AFW pumps are ranked high (DWG M1-0206)?

i. Why are 1-8801A/B ranked low when 1-8815 is ranked high (DWG M1-0261)?

E5-3
What testing is proposed for the main steam dumps to the condenser (1-TV-2370A, B, C, D, E, F, G, H, and J) and the steam generator flow control valves (1-FCV-0510, 1-FCV-0520, 1-FCV-0530, and 1-FCV-0540)? These are valves that are not in the current IST program but were high risk in the IPE.

E5-4
What testing is proposed for the following LSSC valves?

CCW System: X-PV-3583 (DWG M1-0229 Sheet 2 of 8)
X-PV-3584 (DWG M1-0229 Sheet 2 of 8)
X-PV-3585 (DWG M1-0229 Sheet 3 of 8)
X-PV-3586 (DWG M1-0229 Sheet 3 of 8)

CVCS System: 1-8104 (DWG M1-0255 Sheet 2 of 3)
1-8105 (DWG M1-0255 Sheet 1 of 3)
1-8106 (DWG M1-0255 Sheet 1 of 3)
1-8109 (DWG M1-0255 Sheet 1 of 3)
1-8112 (DWG M1-0253 Sheet 1 of 2)
1-8145 (DWG M1-0253 Sheet 2 of 2)
1-8146 (DWG M1-0253 Sheet 2 of 2)
1-8147 (DWG M1-0253 Sheet 2 of 2)
1-8153 (DWG M1-0253 Sheet 2 of 2)
1-8154 (DWG M1-0253 Sheet 2 of 2)
1-8210A&B (DWG M1-0255 Sheet 1 of 3)
1-820[illegible]A&B (DWG M1-0255 Sheet 1 of 3)
1-FCV-0111A&B (DWG M1-0255 Sheet 2 of 3)
1-FCV-0110B (DWG M1-0255 Sheet 3 of 3)
1-HV-8220 (DWG M1-0255 Sheet 3 of 3)
1-HV-8221 (DWG M1-0255 Sheet 3 of 3)

CS System: XCS-0037 (DWG M1-0257)
XCS-0039 (DWG M1-0257)
XCS-0041 (DWG M1-0257)
XCS-0044 (DWG M1-0257)

Liquid Waste Processing System: 1WP-7176 (WP-7196?) (DWG M1-0264)
1WP-7177 (DWG M1-0264)
1-HV-7311 (DWG M1-0264)
1-HV-7312 (DWG M1-0264)

PASS System: 1-HV-4182 (DWG M1-0228)

Main Steam System: 1-HV-2333A
(DWG M1-0202) 1-HV-2334A
1-HV-2335A
1-HV-2336A

1-MS-0021, 0022, 0023, 0024, 0025
1-MS-0058, 0059, 0060, 0061, 0062
1-MS-0093, 0094, 0095, 0096, 0097
1-MS-0129, 0130, 0131, 0132, 0133

Why are the main steam safety valves and main steam isolation valves LSSC for CPSES? Does the FSAR transient analysis take credit for these valves?

1-HV-2452-1
1-HV-2452-2

Why are the main steam supply valves to the auxiliary feedwater pumps LSSC for CPSES? Does the FSAR transient analysis take credit for these valves?

1-HV-2397 A&B
1-HV-2398 A&B
1-HV-2399 A&B
1-HV-2400 A&B

E5-5
What testing is proposed for the following LSSC pumps?

- Spent fuel pool cooling water pumps CPX-SFAPSF-01/-02 (DWG M1-0235 Sheet 1 of 2)
- Safeguards Building sump pumps CP1-WPAPSS-01/-02/-03/-04 (DWG M1-0236)

E5-6
Why are 1-8825 and 8890A/B Appendix J leak rate tested per technical specifications whereas 1-8881, 1-8823, and 1-8824 are not?

E5-7
In the CVCS system (DWG M1-0253 Sheet 2 of 2), is 1CS-8393 (spring-loaded check valve) in the CPSES IST program? If not, why not?

E5-8
Valve 1-8924 (Unit 1 SIP/CCP suction header cross tie isolation valve) (DWG M1-0261) is ranked as an MSSC but the implementation results treat it as an LSSC. Why?

E5-9
Are there any plans to perform partial-stroke testing of any check valves classified as LSSCs during the deferred testing period? Are other test methods, consistent with OM-22, being considered? (see G-3)

E5-10
If the exemption is implemented and testing of solenoid valves differed, would any of these valves be left in the energized position for the entire interval between tests? Is the licensee considering any more frequent exercising of solenoid valves that are not exercised during their deferred test interval? Please comment. (Note NUREG-1275, "Operating Experience Feedback Report - Solenoid-Operated Valve Problems.")

VII. QUESTIONS ON THE USE OF PRA TO RISK-RANK COMPONENTS FOR IST

A. PRA Quality and Scope

The NRC position on PRA quality as articulated in a Staff Requirements Memorandum (SRM) dated April 28, 1995, is that IPE reviews are not of sufficient depth to allow the staff to indicate approval of, or concurrence with, the absolute values and conclusions. The Commission suggested that if there is to be further use of PRAs as a basis for risk-informed regulatory changes, then the industry should, in coordination with the staff, initiate the actions necessary to develop PRAs that are acceptable for regulatory use (i.e., standardized methods, assumptions, level of detail).

Section 3.7 (page 3-11) of Enclosure 3 states that "the CPSES IPE meets or exceeds the quality standards subsequently suggested by the EPRI PSA Applications Guide." While the staff believes that the EPRI guide provides high level criteria to ensure that PRAs will meet some minimum quality standard, it does not supply sufficient details to show that PRAs are adequate for risk-informed regulation such as the extension of IST intervals. A more detailed review process is required. Please provide additional information as identified below.

<u>PRA-1</u>
Page 3-4 of Enclosure 4 discusses the review and QA process that the IPE has experienced including internal and external reviews. Please make review documentation available for review during a site visit. The staff needs to see what the review scope and process consisted of, the review findings and the resolution to these findings. (In particular, the staff needs to see if the following were addressed: consistency with analyses for similar plants; completeness in terms of systems/components modeled, HEPs modeled, IEs modeled; accuracy; realism - generic or plant specific data, modeling of as-built, as-operated plant, assumptions; and reproducibility.) (See E3-9)

<u>PRA-2</u>
Potential areas of concern developed from the IPE submittal that may impact IST issues:

a. Inter-unit cross ties are modeled in the IPE. What is the current operational status of inter-unit cross ties at CPSES? When one unit is in shutdown, are systems depended upon from the other (i.e., operating) unit? Are the cross-tie systems ranked high? Are cross-tie valves ranked high? If not, please justify their omission.

b. The IPE states that post initiator human actions "may or may not be covered by procedures." What SSCs are affected by HEPs that are based on non-proceduralized recovery actions? How was SSC importance adjusted to account for greater uncertainty associated with non-procedural recovery actions?

c. The CPSES IPE relies mostly on generic data. The Expert Panel has re-ranked components higher for IST based on plant operating experience. Are there procedures to systematically collect plant specific data for IST ranking to ensure that SSC ranking is not invalidated by new data? (i.e., please discuss how your plant PRA model will be updated to reflect operating experience)

PRA-3

PRA models were not used for the ranking of SSCs for containment isolation, interfacing LOCAs, seismic events, and outage operations. Therefore, ranking for these events is somewhat inconsistent with that for the internal events. Ranking within each type of initiating event without considering the overall CDF or LERF is inconsistent. Please justify your approach or provide a revised assessment.

PRA-4

In terms of truncation limits used, page 4-36 of Enclosure 4 of the submittal stated that the IPE contains all cutsets above 1E-9. Some cutsets between 1E-8 and 1E-9 were recovered, the others were not. So that recovery actions are uniformly applied, only cutsets above a 1E-8 truncation limit were used in the IST submittal. By reviewing these cutsets and comparing those components that were ranked low but were just below the cutoff in the 1E-8 model with the basic events in the 1E-9 list, CPSES concluded that changing truncation limit from 1E-8 to 1E-9 will not change the ranking of the IST components. The staff has the following concerns regarding the approach. Please justify the adequacy of your approach with respect to the following:

a. The CPSES study of truncation limits consisted of a review of a list of events in the 1E-8 cutset equation versus the 1E-9 cutset equation. The staff concern here is that even though a component is not be to truncated, there may not be enough cutsets to fully represent the component. Therefore, F-V importances could be underestimated if there are many relevant cutsets that are truncated. (For example, with the IPE CDF at 5E-5, a truncation limit of 1E-8 and a F-V criteria of 1E-3, the truncation of as few as 5 cutsets could result in a component being ranked low as opposed to high.)

b. Preliminary sensitivity studies for other plants show that (with CDFs of around 1E-5), truncation limits on the order of 1E-11 or lower are needed to obtain "stable" results in terms of component ranking. These studies show that, because less than 20 percent of the cutsets are kept when truncation limits are increased by factors of ten (e.g., 1E-9 to 1E-8 or 1E-10 to 1E-9), there is usually an insufficient amount of cutsets/sequences at the 1E-8 truncation level to produce robust ranking results. Therefore, to show that CPSES results are not affected by truncation limits, sensitivity studies should be provided to show the CDF and the ranking order of components at truncation levels of 1E-10 and 1E-11. These studies should also show the sensitivity of results to the choice of the specific numerical criteria chosen for component classification (e.g., F-V > 1E-3).

c. Based on a review of the tabulated results (Table 4.1-1 of Enclosure 4), there are 27 components that have F-V of 0.0 and 6 components that have a F-V of 1E-4. Supposedly, these events were modeled in the IPE and appeared in some core damage cutsets. Otherwise, they should have been assigned "n/a" under the F-V column. This needs to be clarified, because any event that appears in any core damage cutset should have a F-V of at least 1.75E-4 (with a total CDF of 5.7E-5 and a truncation value of 1E-8, the F-V of a cutset with frequency of 1E-8 should be 1.0E-8/5.7E-5 = 1.75E-4). It should be noted that considerations such as this could provide a basis for the determination of the truncation limit needed based on total CDF and risk ranking criteria.

Based on the above, please justify why a lower truncation limit should not be utilized for ranking SSCs.

B. Deterministic Considerations

The staff believes that a criteria should be added to the ranking process so that the defense-in-depth concept is not jeopardized by the reduction in IST frequency. The numerical importances for some systems/components are low because of diversity and redundancy. However, changing the IST requirements for one system can influence the risk importance of other systems performing the same function. Therefore, in the absence of more detailed evaluations, redundant means should exist for performing critical safety functions with components that are ranked high.

PRA-5
Maintaining defense-in-depth is mentioned in several places in the submittal, for example in the first paragraph of page 4 of Enclosure 1. However, we do not see evidence of how this is applied. Please provide details of how you met this objective.

PRA-6
A useful way to consider defense-in-depth is to study path sets (combinations of success paths) to determine if at least one success path contains SSCs that are all ranked high. This approach, or other alternative methods, should be used to demonstrate that defense-in-depth is maintained.

C. Expert Panel

PRA-7
The main objective of the expert panel (EP) was to ensure that the risk ranking is consistent with plant design and operating experience. The EP also reviewed rankings and their associated technical basis for IPEEE, outage risk, and LERF (including ISLOCA scenarios and containment isolation valves). For those SSCs not modeled in the IPE, the EP ranked them based on insights from other work.

a. Appendix A to Enclosure 4 is intended to document the Expert Panel Guidance document. This was not made available in the submittal. (Also, the top of page 3-9 of Enclosure 3 references a "Section 4" for the expert panel process. This appears to be an incorrect reference.) The staff will need to review the EP guidance document to verify that the EP process is well defined, systematic, scrutable, and reproducible.

b. If not already included in the EP guidance document, please define the process used to integrate PRA insights with deterministic considerations.

c. Again, if not already included in the EP guidance document, please clarify the following statements from page 4-64 of Enclosure 4:

- "determine, if practical that whether or not mitigating operator actions were included in the IPE." What does the EP do with this information?

- "validate or change the IPE-based ranking, as appropriate." Please describe the validation process and the rationale for changes.

PRA-8
When component ranking is modified by the expert panel, the EP should investigate the reason why the PRA results are not correct and whether or not the PRA needs to be modified. When the EP raises a ranking, this could imply that plant specific data or operating practices show a component to be important and should therefore be included in the PRA. When the EP lowers a rank, this could mean that PRA assumptions (input, etc.) are incorrect and/or conservative. This latter case could cause a masking effect on the other plant components. Please describe how these concerns were addressed.

D. SSC Ranking

PRA-9
When ranking for fires and tornados using IPEEE models (page 4-11 of Enclosure 4), what were the importance criteria used? What was the truncation value used for cutset equation and how many cutsets were in the concatenated equation? What was the CDF from fires and tornadoes and what percent was represented in the concatenated cutset equation?

PRA-10
Seismic ranking: The CPSES IPEEE chose the reduced scope seismic margin evaluation to evaluate seismic vulnerabilities, therefore, no PRA models were available to determine seismic risk. The IST component ranking for seismic is based on qualitative arguments (pp. 4-12 through 4-15 of Enclosure 4). In the qualitative assessment, a LOSP and very small break LOCA, and main steam line break were assumed as initiators. The evaluation does not assume that anything else is failed by the earthquake. A comparison of initiator frequencies with those from the IPE and using the IPE CCDPs, the submittal summarized that seismic risk was not significant. Therefore, no components were added to the high category by the expert panel as a result of seismic

considerations. In making these judgements, does the expert panel contain members that are familiar with the seismic qualification of plant SSCs, or are all insights from the above evaluation provided by the PRA/IPEEE engineer?

PRA-11
Outage risk ranking: A qualitative assessment was done to determine the effect of shutdown modes on component ranking since CPSES does not currently have a shutdown PRA. The following are staff comments on this process:

a. The second paragraph on page 4-17 of Enclosure 4 states that "[o]utage risk evaluations indicate that the outage risk is lower than at power risk. Therefore, there should be no time period of increased risk that would cause an unimportant component at power to be important during an outage if the component performs the same function." Based on this, the CPSES approach to risk ranking for outage configurations assumes that "if a component performs the same function and is in the same initial state as at power, the at power ranking is assumed to bound the outage ranking." The staff agrees that the CDF during an outage is usually (but not always) lower than the at power risk; however, even with a lower CDF, the risk from shutdown operations could be high when compared to those at full power. For example, NUREG/CR-6144 Vol. 6 Part 1, shows that latent cancer risk from mid-loop operations alone (at Surry) is very similar to the risk for all operations at full power. The reason for this is that the containment is likely to be unisolated for a significant fraction of the accidents; therefore, the release to the environment is potentially large. Thus, using CDF alone in this case is not a good measure of risk. Note: A qualitative argument is presented on page 4-19 under "Containment Integrity" to state that the "causes of large early release for shutdown are bounded by the IPE." This argument depends on operator actions to isolate the containment. NUREG/CR-6144 shows that the HEP for this case is large and the HEP is the dominant cause of the large offsite dose risk. Please address these shutdown issues and re-rank the SSCs as necessary.

b. In addition to the above, during an outage, there is a greater likelihood that the redundant train of a system is not available because of maintenance, etc. Therefore, the importance ranking for full power operations might differ from that for outage operations even if the system function is the same. Please address.

c. Although there is no direct one-to-one correlation between the CPSES shutdown categories 1, 2 and 3 components to the high, medium, and low components, the rules used for risk ranking for shutdown (pp. 4-18 and 4-19 of Enclosure 4) appear reasonable when comments from (a) and (b) are taken into account. The staff has some concerns that some components that might be placed in category 2 might belong in category 1 if a more rigorous analysis was performed (for example, the check valves for which reverse flow can fail redundant trains); however, since CPSES is treating both categories 1 and 2 as being "high," this point is currently not relevant. Is there a possibility of shutdown category 2 components being ranked as low risk significant in the future? If not, what is the advantage of having three categories?

PRA-12
Issues related to containment performance: Please address the following.

a. For LERF, please provide the CPSES definition for "Large" and "Early." When referring to the IPE submittal, are all the unisolated and bypass release categories (i.e., V sequence, SGTR and ISGTR, and isolation failures) as well as release categories I and III defined as large early releases? If not, please explain why not.

b. A sentence at the top of page 4-25 states that "... compensatory actions were required for large releases that were not classified as early ..." The staff agrees with the fact that all large releases have to be addressed, since many Level III studies have shown that population dose and latent cancer fatality risks can be dominated by late releases.

   - Does this then include IPE release categories V, VII, and IX?

   - What components were re-ranked as high because of this definition?

   - What are the compensatory actions?

c. Containment spray system components (with the exception of the spray pumps) are ranked low because they are not risk significant in terms of LERF (Table 4.2-1). How significant of a role does containment spray play in long term containment heat removal and in condensation of steam buildup from CCI, i.e., are containment sprays important in terms of all large releases? Again, referring to the IPE, can the operation of containment spray result in the shifting of core damage sequences from the "rupture" to "leakage" categories (i.e., from the large to small release categories) or from the "early" to "late" categories?

d. Concerning SGTR isolation (page 4-27 of Enc. 4), the expert panel ranked as low many steam line isolation valves because of operator actions specified in EOPs that can isolate the leak path. Are the valves specified in the EOPs for isolation purposes ranked high? How much time is available for isolation? What is the HEP?

e. The submittal does not provide enough details on how components were ranked for i) ISLOCA, and ii) safety systems uniquely important to preventing high pressure core melt scenarios. Please provide additional details. Also, in terms of ISLOCA, how will the ISLOCA initiating event frequency be affected with the proposed extended frequencies for low ranked valves?

PRA-13. Questions on the ranking results, Table 4-1 of Enclosure 3:

a. Questions on Table 4-1 of Enclosure 3:

- What is the basis used by the expert panel when they decreased the ranking for the EDG fuel oil transfer pumps to low (FV=0.05, RAW=140)?

- Why is there "no change" for the Containment Spray pumps and its associated components when LERF is considered?

b. Questions on AFW system ranking:

- The turbine-driven pump (TDP) is ranked high. A single failure of the steam supply valve 1-HV-2452 will fail the TDP. Why isn't this valve also ranked high? Similarly, why aren't valves 1-HV-2452-1 and 1-HV-2452-2 ranked high?

- Each of the three AFW pumps can feed each of the four SGs via several redundant paths. Presumably, because of this redundancy, none of the valves in the AFW pump - SG flow path were ranked high. Was there any consideration given to rank some valves as high to assure at least one success path? Also, was there consideration given that the CCF of the valves could increase given increased IST frequency?

c. RHR system: It appears that valves 1-8890A and 1-8890B could result in a flow diversion that could fail system function (somewhat similar to that caused by valve 1-8717). Valve 1-8717 is ranked high, while the other two are ranked low. Why is this the case?

d. Questions on CVCS ranking:

- Valves 1-LCV-112B, 1-LCV-112C, and 1-8440 are in series. The first two are ranked high, while the last is ranked low. Why is this the case?

- Is there a redundant path for emergency boration other than through the low ranked valve 1-8104?

e. FW system: What is the basis for the expert panel in ranking valves 1-HV-2134/2135/2136/2137 high when there are many other low ranked valves in the system which might also fail and cause a loss of feedwater transient?

E. Risk Metrics and Numerical Decision Criteria

PRA-14
Define LERF. Discuss how this is adequate to cover latent health risks (i.e., cancer) for CPSES.

PRA-15
A comparison of the CPSES decision criteria to trial criteria being considered by the staff is as follows:

Final Comanche Peak IST Criteria				
	FV < 0.001	FV ≥ 0.001	FV ≥ 0.005	FV ≥ 0.01
RAW ≥ 10	L*	H	H	H
RAW ≥ 5	L*	H	H	H
RAW ≥ 2	L*	H	H	H
RAW < 2	L	H	H	H

* Low with compensatory measures

Staff Trial Criteria				
	FV < 0.001	FV ≥ 0.001	FV ≥ 0.005	FV ≥ 0.01
RAW ≥ 10	H	H	H	H
RAW ≥ 5	M	H	H	H
RAW ≥ 2	M	H	H	H
RAW < 2	L	M	H	H

The above trial criteria are based on (i) the staff's belief that the components with RAW > 10 should be ranked high regardless of the F-V value; and (ii) a F-V > 0.001 would result in ranking results that are more stable when truncation levels in the range of 1E-9 or 1E-10 are used.

As can be seen from the tables above, the final CPSES criteria (i.e., treating all medium ranked valves as high) are very similar to the trial NRC criteria (if we assume that the NRC "medium" is equivalent to the CPSES "low with compensatory measures"). The only difference is in SSCs with F-V < 0.001 but RAW > 10. If we adopt the NRC criteria, the following four CPSES components will have to be added to the "high" category: 1-HV-4699, 1-HV-4700, 1CC-0061, and 1CC-0031 (by symmetry). Please justify the CPSES criteria, or justify why the above four valves should be ranked low.

F. Sensitivity Studies (see E4-20 & 25)

PRA-16
Effect of initiating events on ranking: The submittal (Section 4.2.5) identified the component cooling water system, service water system, and safety chilled water system as being potentially important systems (with

respect to IST) that contribute to both core damage mitigation and initiating event frequency. Fault trees were used to determine the initiating event frequency. The submittal then stated that the components that are important to core damage mitigation are also the same ones that are important as trip initiators. There was no requantification of the model with the initiators represented by fault trees (single basic events were used to represent the initiating events). In order to better understand the CPSES conclusion, please provide the staff with the fault tree models for each of these systems, both as initiating events and as core damage mitigating systems.

PRA-17
As a follow-up question, how has the loss of MFW initiating event (which is a 8.8% contributor to CDF according to the IPE) been considered?

PRA-18
Effect of common cause failures (CCFs): In the IPE, the Multiple Greek Letter (MGL) parameters applied in the CCF analysis were obtained by the Bayesian updating technique: generic CCF data had been screened to determine Comanche Peak specific "prior parameter distributions" which were then updated with CCF events ("evidences") experienced at the plant. The process resulted in proper "posterior" MGL parameters. In the absence of plant specific events, the posterior MGL parameters are "prior dominated," i.e., strongly biased (usually downward) by the screening process. (The process seems to allow neglect of CCF events that have not yet occurred at the plant or were not identified.) The staff has concerns that the increase in IST frequencies might influence plant specific CCF events and therefore the IPE estimates of CCF probabilities.

For those components for which CCF contributions are not included in the PRA models and this exclusion is justified based on the historical and engineering evidence driven by current requirements, there would be no assurance that the CCF contribution will not become significant under the proposed exemption request. Therefore, sensitivity studies could identify those components which can shift to a high category as a result of uncertainties in CCF rates.

In discussing the results of the CCF sensitivity study, the IST exemption submittal included the effects on components where CCFs were already modeled. Did the importance of components where CCF was not modeled increase as a result of the removal of CCFs from all components? (i.e., did CCFs mask the importances of components that are not originally modeled with CCFs?) Also, were there components that were ranked low because CCF was not included in the PRA model. If so, the CCF models should be revisited to provide reasonable assurance that the assumption of no CCF is still valid with extended IST frequencies.

PRA-19
Effect of recovery actions (component importance due to human errors): The concern in this area stems from situations where very high success probabilities are assigned to recovery actions in sequences, therefore resulting in related components being risk insignificant. Furthermore, it is not desirable that the ranking of SSCs be significantly impacted by recovery

actions which are only modeled for limited scenarios. Therefore, SSCs should be re-ranked without recovery actions. The CPSES submittal indicated that risk ranking was not affected by the removal of recovery actions. Similar to a question raised earlier on the "quality" of the PRA, can you please discuss the effect of non-proceduralized recovery actions on ranking? Please also provide a list of SSCs that are affected by non-proceduralized HEPs, the HEPs used, and a justification for the HEPs.

PRA-20
Multiple component importance: In risk ranking, the SSCs are binned based on single event importances. For those components assigned in the low category, one needs to have reasonable assurance that the aggregate impact of multiple components is negligible. The multiple component importance measure should identify which combination of SSCs might be risk significant, therefore requiring them to be shifted to a higher category.

The CPSES submittal calculated the RAW of components taken two at a time, and identified two components that had low RAW individually and high RAW when combined with other events. These 2 components were ranked as if their individual RAW was high. F-V rankings were not affected.

a. In general, multiple component cutsets (containing three or more events) are lower in frequency. Therefore, it would be reasonable to expect more multiple component combinations when using lower truncation values. When comparing the 1E-9 cutset list to the 1E-8 list for CPSES, how many more multiple component cutsets (ranked low) are identified? (i.e., does the 1E-8 equation contain sufficient combinations to this study to be effective?) (See PRA-4)

b. How did the submittal treat super-components that might contain low ranked components in their search for low ranked SSC combinations?

PRA-21
Ranking from dynamic plant configurations: The submittal did not evaluate the effects of the different plant configurations on component ranking. The areas where this might be important are periods where there are scheduled maintenance or rolling maintenance when pre-specified sets of components are brought down for maintenance for a pre-specified amount of time. This issue should be addressed.

PRA-22
PRA Uncertainty: One of the ways to check for uncertainty effects is to identify the major uncertainties in the PRA and to evaluate the effects on the risk importance. The evaluations can be qualitative or quantitative. The PRA modeling effects on risk importance evaluations can be evaluated by using sensitivity calculations (as was done by CPSES for issues like CCF, recovery factors, initiating events, etc.). The effects of PRA data uncertainties can be evaluated by carrying out uncertainty propagation for selected risk

importance values. An importance analysis using the fifth and ninety fifth percentile of the unavailability distributions could be performed to determine the range of variations in F-V measures. Ranking of some components with large uncertainties (such as check valves) could vary and these component should be ranked in the higher category to account for the uncertainty distribution.

G. Verification and Validation Cases

PRA-23
A calculation was performed to determine the increase in CDF due to the increase in failure probabilities of LSSCs. Two cases were considered: one assumes that compensatory measures (assumed to be as effective as the IST program) were applied to LSSCs with high RAW values, and the other assuming no compensatory measures. In the first case, CDF increased by 75%, given a factor of 100 increase in the failure probabilities of LSSCs. In the second case, the increase is 25%.

a. The above results appear to be an underestimation of the risk impact from all components in the low or non risk category, as compared with a simple lower-bound estimate of the increase in CDF using the component F-V importance. There are approximately 50 IPE components in the low risk category. They have a total F-V of approximately 1.67E-2, obtained by simply summing the F-Vs of the components. Summation is done based on the assumption that these components do not appear in the same core damage cutset. This assumption leads to a lower bound estimate of the resulting increase in CDF, because if the components appear in the same cutset, the increase in CDF would be higher. Considering the case that the failure probabilities of the low risk components

PRA-24
In the sensitivity study, the test interval was varied, however, the failure rate was left constant. Given the fact that the study increased test intervals by factors of up to a hundred, it is very hard to postulate that the failure rate would stay constant. [Data that is available is based on the current test intervals, i.e. 3 months, 1 year, or maybe 18 months. Therefore, to apply the current failure rates for test intervals that increase by factors of up to 100 does not appear appropriate]. The staff does not have confidence that constant failure rates would be valid for the test intervals proposed in the submittal. It would be logical to assume that after a certain time period the effects of aging, corrosion, material deposition, etc., will result in an increase in component failure rates.

Finally, the submittal pointed out that the risk increase starts to become non-linear when component unavailabilities are increased by factors of 40 or more. With the proposed IST frequency increase from 3 months to 6 years for many components, the increase in the failure rate is assumed to be 24 (6 x 12 / 3 = 24). Therefore, even if you are off by a factor of two in your assumption of failure rates because of lambda being non-linear, (i.e., if failure rates for IST frequency increase from 3 months to 6 years is 48 instead of 24), we are into the non-linear zone for risk increases.

Keeping the above discussion in mind, please justify the assumption on linear failure rates, and your proposed test interval.

PRA-25

Since ranking was done within each PRA model and does not account directly for IPEEE and shutdown risk, the calculated V&V increase is only based on internal events results. How will the V&V results and conclusions be affected if external events and shutdown risk were included?

PRA-26

Does the V&V include the increase in initiating event frequencies from the loss of the CCW, SWS and SCWS support systems? Increased unavailabilities from components ranked as LSSC in these systems could affect the initiating event frequencies.

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

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

REQUEST FOR ADDITIONAL INFORMATION REGARDING

RISK-INFORMED INSERVICE TESTING (RI-IST) PILOT PLANT

The following are the initial questions and comments that have been developed by several NRC staff reviewers who have been reviewing the Palo Verde exemption request. We have attempted to remove redundant questions from the different reviewers and to order the questions generally according to the order of the material presented in the submittal. There may be some redundancy remaining. In the responses to these questions, it is acceptable to refer to other questions for parts of answers or to other documents when appropriate.

I. GENERAL QUESTIONS INCLUDING THOSE RELATED TO THE APS TRANSMITTAL LETTER

G-1
The first ten-year interval of the Palo Verde Unit inservice testing (IST) program was scheduled to expire on January 28, 1996. Apparently, the submittal for the second ten-year interval has been delayed. Please give a status of this effort and provide a proposed implementation schedule. Will this effort proceed concurrent with the proposed exemption request for the Palo Verde IST program or is the second ten-year update dependent on the approval of the exemption request? (see E1-1 and G-4)

G-2
Were any check valves categorized as LSSCs that are currently disassembled and inspected in accordance with the guidance of GL 89-04, Position 2? If so, will there be any proposed changes to the inspection schedule?

G-3
OM-1 establishes different test frequencies for different classes of safety/relief valves. Class 1 valves are tested once every 5 years. Class 2 and 3 valves are tested once every 10 years. It appears that all Class 1 relief valves in Palo Verde's IST program have been classified as MSSCs and Class 2 and 3 valves have been classified as LSSCs. What changes in the test frequency is the licensee proposing for the Class 2 and 3 valves?

G-4
What acceptance criteria are used for the full-stroke open test of the LPSI, HPSI and containment spray pump discharge check valves and the LPSI and containment spray pump suction check valves? If the acceptance criteria are based on achieving a specific flow rate during pump inservice testing, would the acceptance criteria change if the exemption request is implemented? (see G-1)

G-5
Are there any plans to perform any partial-stroke testing of any check valves classified as LSSCs during the deferred testing period? Are other test methods, consistent with OM-22, being considered?

G-6
What is the testing schedule for LSSCs that can only be tested during cold shutdowns or refueling outages? How would you propose these components to be addressed in the deferred test justifications that are evaluated during the 10-year IST program intervals?

G-7
Some licensees have claimed in relief requests that stroke-time testing of solenoid valves provides no information because either the valve strokes or fails and therefore no determination of degradation can be made. It appears that virtually all solenoid valves in the Palo Verde IST program are classified as LSSCs. Are all solenoid valves at Palo Verde exercised as a result of normal plant operations, whether it be at power, cold shutdowns or refueling outages? If the exemption is implemented and testing of solenoid valves differed, would any of these valves be left in the energized position for the entire frequency? Is the licensee considering any more frequent exercising of solenoid valves that are not exercised during their deferred test interval? Please comment.

G-8
The sensitivity studies described in section 4.2.5 do not appear to adequately explore whether components could easily change from one category to another as a function of:

a. failure rates which could be age-dependent,

b. component unavailability assumptions which tend to vary with service condition, and

c. small variations of the decision criteria [i.e., F-V and RAW thresholds].

(see PRA-13 and PRA-15 through 20)

G-9
Staff approval of an exemption from the requirements of 10 CFR 50.55a (f) does not relieve the licensee of its responsibility to comply with technical specifications (TS).

II. QUESTIONS ON ENCLOSURE 1 - EXEMPTION REQUEST

E1-1
The test frequencies referenced in the Enclosure 1 table are based on the 1980 edition of ASME Section XI. The licensee's second ten-year IST interval will be based on OM-1 for relief valves, OM-6 for pumps, and OM-10 for valves other than relief valves. This table should be revised to reflect the applicable code references. (see G-1)

E1-2 (page 2)
Under Item 1, it is stated that two SSC groups were used, the MSSC and the LSSC groups. Later in the submittal (such as in the table on page 11 in Enclosure 3) a 3rd "Medium" grouping for intermediate safety significant SSCs is used. We found this apparent inconsistency confusing although the use of the Medium group was identified later. A broad question during this program is going to be the concerns associated with how to deal with SSCs that are borderline, those that, considering uncertainty, fall so close to whatever cutoff criteria are used, might well belong in either group. See Figure 1 which is a plot of RAW vs. F-V importance (at the end of this question list). This plot is a fairly typical example of the relatively large number of plant components that can fall in the borderline mid-range of the cutoff criteria. This issue is connected with later questions that we have identified about the details of how the Expert Panel carried out its decision process. For this specific area, please provide a more detailed discussion of how the medium group was resolved into the higher or lower safety significant groups. (see PRA-13)

E1-3 (page 2)
Under Item 1, it is stated that all pumps and valves whose function is required for safety will continue to be tested in accordance with the ASME Code. To be consistent with later statements in your proposed program, shouldn't this statement be revised to indicate that improved test methods may be identified for the MSSCs through the ASME O&M Committee work described on page 4 of Enclosure 3 of your submittal? (see E3-2)

E1-4 (page 2)
Under Item 3, it is stated that the RB-IST Program Description may be changed without prior NRC approval provided the changes do not have an adverse impact on plant safety. Please describe what criteria will be used to make that determination. (see E1-7)

E1-5 (page 3)
The next to last paragraph of this page states that one MSSC that was not originally in the IST program and that, although it is outside of the ASME Code class boundary, it is planned to test that component because it has safety significance. It is important that the details concerning such cases be well documented so that an improved understanding can be achieved of this

whole process of using risk information. Accordingly, please provide more detailed information about this component (and any other such components) including the information used to determine its risk significance, the proposed test strategy, and information on its associated Code class boundary, etc. (see E5-1 and E3-26)

E1-6 (page 4)
In the 5th paragraph on this page, it is stated that Item 3 of the exemption request will allow certain changes to be made to the methodology without NRC approval. Please describe the criteria that will be used to distinguish when changes will be approved through the NRC and when they will not. If there is a single set of criteria that applies to the statement made on this page and the similar issue addressed as E1-4 above, a single answer is fine. (see E1-4)

E1-7 (page 4)
Paragraph 6 of this page discusses that changes in IST test frequencies will be provided to the NRC in regular program updates. How frequently are these updates envisioned? (see E2-6)

E1-8 (page 4)
The next to last paragraph of this page discusses the negative aspects of overly extensive testing of components, from component wearout and system unavailability to personnel radiation exposure. We agree that all of these negative aspects exist and wish to develop a better understanding of the potential impact on your plant. Accordingly, please provide a summary of any analyses that you have performed to assess these important factors.

E1-9
The exemption request (page 3 of 5) states that:

> Components in the current ASME Section XI IST Program which are MSSCs will continue to be tested in accordance with the current IST Program, which meets the requirements of Section XI of the ASME Boiler and Pressure Vessel Code, except where specific written relief has been granted.

The licensee should describe its method for determining the test frequencies of both the LSSCs and MSSCs. If the test frequency for the MSSCs was based solely on the Code test frequency, and not through a risk analysis, discuss why this is acceptable.

III. QUESTIONS ON ENCLOSURE 2 - RISK-BASED IST PROGRAM DESCRIPTION

E2-1 (page 1)
In the 1st bullet on this page it is stated that candidate components for extended frequencies were placed in the LSSC category by a blending of probabilistic and deterministic methods. Please describe the criteria used for accomplishing this blending.

E2-2 (page 1)
Section 2 states that testing of an LSSC can be deferred to once every 6 years after two successful tests. Valves would be arranged into groups similar to those described in GL 89-04, Position 2, and tested on a staggered basis. However, for valves that are tested quarterly, a large number of valves would become eligible for deferred testing six months after approval of the exemption request. The NRC will need to review the actual component groupings, the detailed grouping criteria, and sample expansion criteria in order to evaluate the adequacy of this phased-in approach. Also, please describe the implementation schedule to achieve deferred testing on a staggered basis.

E2-3 (page 1)
Section 2 of Enclosure 2 states that "[t]he test frequency of certain LSSCs in the IST Program shall initially be extended to once every 6 years." The test interval for LSSC must be supported by performance data such that the licensee can reasonably expect to find that the component is functional when the inservice test is performed. Therefore, the risk analysis should be supported by performance data for the proposed test interval i.e., the PRA should be supplemented by deterministic methods, such as performance history, to evaluate the acceptability of the proposed test frequency. Furthermore, there should be a performance based feedback mechanism in place to ensure that any adverse or ineffective test strategies are promptly detected and revised.

E2-4 (page 1)
Describe the PVNGS corrective action program that is referenced in Section 2 and exercised in the event that an LSSC fails its inservice test. What criteria would be used to initiate testing of the remaining valves in that group? The corrective action should explicitly include consideration of the need for revising the test frequency. The staff would like to review, during a site visit, any PVNGS procedures or program documents that provide assurance that failures of IST components will be promptly identified and addressed and modifications to the inservice testing program (e.g., changes to the surveillance intervals) are made in a timely manner.

E2-5 (page 2)
Item 4 states that the aggregate impact of multiple changes to test frequencies will be evaluated by one or both of (1) Expert Panel review, and (2) updates to the PRA models and analyses. Please provide the rationale (criteria) to decide when and when not to use both of these approaches. Also describe how the aggregate impact will be evaluated including any "cutoff" criteria beyond which further changes may not be allowed. (see PRA-6)

E2-6 (page 2)
Item 5 on this page states that the need to update the PRA will be evaluated every 18 months. Please expand on why this particular interval is planned for maintaining your living PRA. For example, presumably there will be some criteria that the licensee will use at the end of each 18 months to determine if there has been sufficient and significant changes in the plant systems or in PRA analysis areas that a PRA update would be justified. Please describe such criteria. Also, does the licensee envision that an update would be made sooner in certain instances, e.g., if new data became available that was judged to potentially have a significant impact on the ranking of the SSCs? (see E1-7)

E2-7
If it is to be used, describe how the ASME Code Case OMN-1 may be used in conjunction with the risk-informed IST program.

IV. QUESTIONS ON ENCLOSURE 3 - RISK RANKING DETERMINATION STUDY SUMMARY REPORT

E3-1 (page 3)
Section 1.0 states that there are possible savings from risk based testing including reduced costs for developing test criteria at design basis conditions. Yet, testing MSSCs in this manner is not required by the current Code (but could be a more effective means for detecting important failure modes and causes). Please comment.

E3-2 (page 4)
In the first paragraph on this page it is stated that the ASME O&M Committee is to make recommendations about possible improvements for the MSSCs. The licensee should clarify the relevance of this activity to their exemption request (i.e., does the licensee anticipate incorporating revised ASME Code test strategies into their risk-informed IST program?). Please give us any updated information about the schedule for this activity and how the licensee plans to evaluate the potential value of utilizing this information in its IST program. (see E1-3)

E3-3 (pages 4 and 5)
Starting at the bottom of page 4 under the section titled "Direct Safety Enhancements," the first and last bullets appear to contradict each other as written and may be misleading. Some revised wording is suggested here to clarify the greater attention that will be given to the MSSCs (e.g., the thought that the revised IST program could result in some MSSCs being tested with higher frequencies and others with lower frequencies with the overall intent of enhancing safety). (This comment also applies to discussion in Section 2.1 of Enclosure 4.)

E3-4 (page 6)
In the second bullet on this page, describing the three phases of the IST project, it indicates that component performance was used with risk insights to make decisions about what components should be deferred. Please describe what role component performance played in making such decisions together with risk information.

E3-5 (page 7)
In the second paragraph of this page, it is stated that the methodology described in this document is consistent with the EPRI/NEI PSA Applications Guide generally. Please identify any areas that you consider significant where you deviated from the guidance in the PSA Guide and your reasons for doing so.

E3-6 (page 7)
The second bullet states that sensitivity studies were used to compensate for limitations in the quantitative PRA models. Please describe how each sensitivity study was carried out and the results. (see PRA-15 through PRA-20)

E3-7 (page 7)
The fourth bullet on this page states that IST engineers will review past performance and service conditions of LSSCs to determine if they warrant extended test intervals. Will the Expert Panel review such cases and what criteria will be used by both the IST engineers and the panel (if the panel is involved)?

E3-8 (pages 7 & 8)
At the end of page 7 and top of page 8 it is stated that, while core damage prevention has been found to be a good measure of the spectrum of releases that can result from severe accidents, several components have been identified that do not impact core damage frequency yet they do have a large impact on fission product release potential. Please identify such components. (See also E3-12.)

E3-9 (pages 8 & 9)
Item 3.3 titled "Completeness Issues" starting on page 8 describes what was done to compensate for the limitations in the PRA quantitative risk models. The five bulleted items briefly describe evaluations aimed at: truncation limits, masked components, common cause, operational concerns and sensitivity studies. We believe that these are extremely important issues concerning the adequacy of the PRA models used, and the description is not sufficient for us to understand how each of these issues was evaluated and the results. Please expand this area to more fully explain what was done and what was learned.

E3-10 (page 9)
Item 3.4 on "Cumulative Effects of Test Interval Changes" is, similarly to Item 3.3 (E3-9), too brief for us to fully understand what was done. This is another area that we have been very interested in learning more about its ramifications and possible approaches for avoiding unacceptable risk levels. Please provide an expanded discussion of how this issue was evaluated and what the results were.

E3-11 (page 10)
In Section 3.5, areas of expertise are identified for the Expert Panel. Do one or more of these areas include experience in inservice testing?

E3-12 (page 10)
In Section 3.5.1, the first paragraph discusses the emphasis on using core damage frequency as the primary figure of merit. Please provide a discussion of your views on how to maintain a prudent balance between the emphasized use of CDF and challenges to the containment (defense in depth). (See also E3-8.)

E3-13 (page 11)
The paragraph directly under the table discusses how components were initially categorized. The explanation of this process is not clear. Please provide an example of how this was done (referring to specific components).

E3-14 (page 11)
The explanation under "Qualitative Criteria" is difficult to understand. An example referring to how specific components were treated would help.

E3-15 (page 12)
The table and discussion regarding your requirements for Expert Panel membership show that six categories were defined and that the actual Panel reflected over 106 years of experience. How many Panel members were used in the total and what categories did each come under? (See E3-11)

E3-16 (page 12)
Under Process Considerations, System Level Screening, the approach for using the previous Maintenance Rule ranking and the PRA information is described. Please provide a summary of how the Maintenance Rule ranking was performed or refer to another document for a more detailed explanation. For example, how were cases resolved in which a component did not clearly fall either into the MSSC or LSSC categories and some additional criteria had to be applied?

E3-17 (page 12)
In the last paragraph, under Deterministic Evaluation, the submittal indicated that certain components of high reliability were removed from the MSSC category.

a. What criteria were used to determine when the reliability was sufficiently high to justify removal?

b. Was the determination of a sufficiently high component reliability based on plant-specific data or generic data or a mix?

E3-18 (page 13)
In the second bullet, under Initiating Events, it is stated that an exception to placing a component in the MSSC category was when the probability of failure was considered to be extremely low. Please define what criteria were used to determine this condition.

E3-19 (page 13)
Under External Events, it is stated that all components not screened out during the system level screening were evaluated based on external events information.

What consideration was given to the screened-out components from the effects of external events?

E3-20 (page 13)
Under External Events, what cutoff criteria were used to determine that the frequency of an event was improbable?

E3-21 (page 13)
Under Reconciliation with Quantitative Results, it is stated that components were classified high risk if the initial disposition was high risk but the quantitative results indicated low risk. In such cases, was an attempt made to determine if modifications to the PRA were appropriate to better model component importance?

E3-22 (page 13)
Under Reconciliation..., the Panel's procedures are described when quantitative results were in conflict with the initial disposition and that sensitivity studies were required (where possible). When such studies were not feasible or not possible, what approach was used to resolve such differences?

E3-23 (page 13)
Under Reconciliation..., the process described is difficult to understand. Please provide an example that refers to specific components to show how the process was carried out.

E3-24 (page 14)
Under Item 4.2, the 5th bullet states that both PRA and design basis functions were compared in an integrated manner. Please provide additional explanatory information to clarify what is meant by this. How was this integration carried out?

E3-25 (page 14)
The last sentence states that the proposed IST program is considered by the Expert Panel to have appropriate changes while maintaining an acceptable level of plant safety.

a. Has there been a requantification of the PRA to estimate the overall effect on plant CDF assuming all of the proposed changes are implemented? If so, please summarize the results. If a requantification has not been performed yet, but planned for the future, when would the results be available? For such a requantification, what risk parameters changes would be evaluated and what criteria used to judge an acceptable increase?

b. It is indicated that the PRA model will be updated to include IST components that were so far omitted from the plant's risk model. What is the schedule for submitting the results of this update?

E3-26
What criteria were used to classify check valve AFNV012 as an LSSC? Please indicate why only one valve that was outside of the Palo Verde IST program was classified as an MSSC? Were there LSSCs outside the IST program? If so, please identify them and indicate their testing under the risk-informed program. (see E1-5 and E5-1)

E3-27
It is indicated that risk rankings of plant system components are complemented with rankings based on consideration of "external" accident initiators (e.g., fires, tornados, and earthquakes) and plant operating modes (shutdown). These rankings consider "importances" with respect to core damage prevention and prevention of large early releases (LERF).

It is not clear, however, whether or not:

a. these studies are based on the updated plant model,

b. the LERFs also included the contributions due to external events,

c. the shutdown plant model includes the external events.

Please clarify these areas.

E3-28
The staff would like to review the detailed system notebooks, the human reliability analysis, and the results of all independent IPE review activities during a site visit. (see PRA-1c)

V. QUESTIONS ON ENCLOSURE 4 - RISK RANKING DETERMINATION STUDY

E4-1
Why were check valves SIAV522, SIAV523, SIBV532 and SIBV533 (DWG) categorized as LSSC's even though these valves have a high shutdown risk? Please provide more information regarding the categorization decision than given in Enclosure 4. (see PRA-10 and PRA-12b)

E4-2 (Section 4.1)
As part of a site visit, the staff would like to review the Expert Panel meeting minutes, or other relevant documentation, in order to understand the Expert Panel's basis for ranking unmodeled components. What criteria were used by the Expert Panel to classify valves? Were any valves classified as MSSCs based on maintenance considerations? (see PRA-7 & 8)

E4-5 (Section 4.4.5)
The sensitivity studies do not appear to adequately explore whether components could easily change from one category to another as a function of:

a. failure rates which could be age-dependent,

b. component unavailability assumptions which tend to vary with service condition, and

c. small variations of the decision criteria [i.e., F-V and RAW thresholds].

(see PRA-13 and PRA-15 through 20)

VI. QUESTIONS ON ENCLOSURE 5 - IMPLEMENTATION RESULTS AND REVIEW OF SYSTEM DRAWINGS

E5-1
Specify the testing to be performed on the one MSSC that is not currently in the IST program. (see E1-5 and E3-26)

E5-2
Supply a list of the 115 valves identified as "NYL" valves. What further evaluations have been performed on these components? Have any been added to the IST program or designated for more testing commensurate to safety significance?

E5-3
Please list valves that are identified as "YYL" or "YNL" valves which are currently tested only during regular IST and would not be exercised for any other reason during plant operation, cold shutdowns, refueling outages or as a result of another IST test such as pump testing.

E5-4 (Table 2)
Describe the difference between the valves listed in Table 2 and the valves listed in Table 4 that are low risk significant and not included in Table 2. (Note that the LSSCs in Table 4 that are not included in Table 2 are predominantly manual isolation valves but also consist of some check valves, air-operated valves, motor-operated valves and relief valves.)

E5-5 (Table 4)
Describe in greater detail than contained in Enclosure 4 why these valves were ultimately ranked as LSSCs. (see PRA-12 & 13)

Valve	Description	RAW	DWG
AFAV015	AFW discharge isolation	2.38	13-M-AFP-001
AFAV016	AFW discharge isolation	2.38	13-M-AFP-001
AFAV137	AFW discharge check valve	2.38	13-M-AFP-001
AFAV024	AFW discharge check valve	8.97	13-M-AFP-001
AFAV025	AFW discharge check valve	8.97	13-M-AFP-001
AFAV138	AFW discharge check valve	8.97	13-M-AFP-001
AFNV013	AFW P01 discharge isolation	2.59	13-M-AFP-001
CHBHV0530	RWT outlet isolation	2.06	13-M-CHP-002
SIAHV0698	HPSI header discharge isolation	4	13-M-SIP-001
SIBHV0699	HPSI header discharge isolation	4	13-M-SIP-001
SIAV476	HPSI PP "A" discharge isolation	2.24	13-M-SIP-001
SIBV478	HPSI PP "B" discharge isolation	2.24	13-M-SIP-001
SPAVH0049A	Isolation for SP "A" inlet line	3.2	13-M-SPP-001
SPBVH0050A	Isolation for SP "B" inlet line	3.2	13-M-SPP-001

E5-6

There were several combinations of valves noted where an LSSC was adjacent to an MSSC and it would appear that both should be in the same category. Below is a list of these combinations (there may be others). Please provide an explanation for each case.

LSSC Valve	MSSC Valve(s)	DWG
CHAHV0531	CHAV306	13-M-CHP-002
CHBHV0530	CHBV305	13-M-CHP-002
CHAHV0524	CHEV429 & CHEVM70	13-M-CHP-001
CHEV433	CHEV435	13-M-CHP-001
SIAHV0687	SIAUV0672	13-M-SIP-001
SIBHV0695	SIBUV0671	13-M-SIP-001

VII. QUESTIONS ON THE USE OF PRA TO RISK-RANK COMPONENTS FOR IST

A. PRA Quality and Scope

The NRC position on PRA quality as articulated in a Staff Requirements Memorandum (SRM) dated April 28, 1995, is that IPE reviews are not of sufficient depth to allow the staff to indicate approval of, or concurrence with, the absolute values and conclusions. The Commission suggested that if there is to be further use of PRAs as a basis for risk-informed regulatory changes, then the industry should, in coordination with the staff, initiate the actions necessary to develop PRAs that are acceptable for regulatory use (i.e., standardized methods, assumptions, level of detail).

PRA-1
The submittal (Enclosure 4, Section 4.0) states that the 1994 version of the PVNGS PRA was used as the basis for the determination of quantitative risk ranking. It also states that the methodology is consistent with the EPRI PSA Applications Guide.

a. Please describe the differences between the version of the PRA used to that submitted in the IPE process. Please provide documentation of this PRA for staff review. Also, please include the cutset equation and the associated database used for the risk importance ranking.

b. In addition, please discuss the "quality" of this PRA in terms of its applicability to IST risk ranking. Note that while the quality standards suggested by the EPRI PSA Applications Guide provide high level criteria to ensure that PRAs will meet some minimum quality standard, it does not supply sufficient details to show that PRAs are adequate for risk-informed regulation such as the extension of IST intervals. A more detailed review process is required.

c. As part of the discussion on PRA quality, please provide information on the review and QA process that the PRA has gone through including internal and external reviews. Please provide review documentation to the NRC during a site visit. The staff needs to see what the review scope and process consisted of, the review findings and the resolution to these findings. (In particular, the staff needs to see if the following were addressed: consistency with analyses for similar plants; completeness in terms of systems/components modeled, HEPs modeled, IEs modeled; accuracy; realism - generic or plant specific data, modeling of as-built, as-operated plant, assumptions; and reproducibility). Please keep in mind that, in general, the IPE studies and the NRC review of these studies alone are not sufficient to support licensing actions and other safety applications.

PRA-2
Since ranking results are influenced by the reliability data assigned to the component, please provide the component unavailabilities used and note whether the data are plant specific or generic to the industry.

PRA-3
PRA models were not used for the ranking of SSCs for containment isolation, interfacing LOCAs, external events, and outage operations. Therefore ranking for these events is somewhat inconsistent with that for the internal events. Ranking within each type of initiating event without considering the overall CDF or LERF is inconsistent. Please justify your approach.

PRA-4
In terms of truncation limits used, page 24 of Enclosure 4 of the submittal stated that the final cutset equation used (after recovery was applied) contains cutsets above 1E-9. The submittal also stated that there are plans in the future to solve the model at lower limits (i.e., 1E-10 or 1E-11).

a. In the final cutset equation, were recovery actions uniformly applied to all cutsets, or only to the dominant cutsets?

b. When will the quantification results for model solutions at truncation values of 1E-10 or 1E-11 be available? In the absence of these runs, what assurance is there that the 1E-9 equation contains enough cutsets to fully represent the low ranked components? How did the licensee ensure that the importances were not underestimated because cutsets had been truncated? Note: Studies show that (with CDFs around 1E-5) truncation limits in the order of 1E-11 to 1E-14 are needed to obtain "stable" results in terms of component ranking.

c. How will the 1E-10 and 1E-11 truncated models be applied? It is envisioned by the staff that, when completed, the 1E-10 and 1E-11 sensitivity results should demonstrate whether or not the CDF and the ranking order of components at these truncation levels are reaching an equilibrium. These studies should also show the sensitivity of results to the choice of the specific numerical criteria chosen for component classification (e.g., F-V > 1E-3, F-V > 1E-2, RAW > 2).

B. Deterministic Considerations

The staff believes that criteria should be added to the ranking process so that the defense in depth concept is not jeopardized by the reduction in IST frequency. The numerical importances for some systems/components are low because of diversity and redundancy. However, changing the IST requirements for one system can influence the risk importance of other systems performing the same function. Therefore, in the absence of more detailed evaluations, there should be a requirement that redundant means exist for performing the critical safety function with components that are ranked high. Adopting this concept will also minimize the potential for inter-system common cause failures which might be introduced by the decrease in test frequency for groups of similar components.

PRA-5
A useful way to consider defense-in-depth is to study path sets (combinations of success paths) to determine if at least one success path contains SSCs that are all ranked high. Please use this approach or provide an alternative method for ensuring that defense-in-depth is maintained.

C. Expert Panel

PRA-6
According to the submittal (Section 4.1), the main objective of the expert panel (EP) is to determine the final ranking based on deterministic insights, plant history, engineering judgement, regulatory requirements and PRA insights. The EP also considered PRA limitations including evaluating IST components not modeled in the PRA, identifying components with operational concerns or non-severe accident risks, assessing impact on containment isolation, assessing impact on initiating event frequency, and assessing failures on operator response. (see E2-5)

a. The staff will need to review the guidance document to verify the process, procedures and philosophy used by the EP. The intent here is to ensure that the EP process is well defined, systematic, scrutable, and reproducible.

b. The first step in the EP process is a system level screening which is based on the Maintenance Rule screening. Please describe the system level screening criteria used for PVNGS for the maintenance rule.

c. The first page of Enclosure 5 (under the description for Table 2) states that performance histories for LSSCs are being reviewed. When will this review be completed? How will the performance histories be accounted for by the EP? Is there a systematic procedure to obtain plant specific component performances?

PRA-7
The integration of PRA insights with deterministic considerations for final ranking of components is summarized in Table 3 of Enclosure 4. This integration process allows for the EP to re-rank a component that was originally ranked by the PRA as High or Medium to a final ranking of Low. (see PRA-2)

a. The criteria to allow for this re-ranking are not clear. Are there rules specified and documented?

b. One of the EP criteria is that "components ... were considered of high safety significance unless there was a high degree of confidence in the high reliability of the component." How is the effect of lowering IST frequency on component reliability taken into account for these cases?

c. A review of Appendix C of Enclosure 4 shows that many components were ranked lower in the final analysis (than the PRA ranking) based on qualitative arguments on redundancy, and/or on low probability of failure. The fact that there is redundancy or that the failure probability is low is already factored into the PRA importance ranking. For example, the F-V rankings already account for multiple train configurations and basic event unavailabilities. The EP should only be allowed to modify the ranking in these cases if it has justifiable reasons to feel that the PRA model or input is not correct. Please justify your approach.

d. Conversely, Appendix C of Enclosure 4 also shows that many components were ranked higher in the final analysis than the PRA ranking. (Examples include the pressurizer safety valves, steam supply to the AWF pump, MSIVs, and main steam relief valves.) The likely causes of a low PRA ranking are redundancy of the components and/or low probabilities of failure. The inconsistency in the treatment of this set of components to those in the previous comment has to be resolved.

PRA-8
When component ranking is modified by the expert panel, the EP should investigate the reason why the PRA results are not correct and whether or not the PRA needs to be modified. When, the EP raises a ranking, this could imply that plant specific data or operating practices show a component to be important and should therefore be included in the PRA. When the EP lowers a rank, this could mean that PRA assumptions, input, etc. are incorrect and/or conservative. This later case could cause a masking effect on the other plant components. Please describe how these concerns were addressed. (see E4-2)

D. SSC Ranking

PRA-9
External Events risk ranking: According to the submittal (Section 4.1.3.4), "each component was reviewed to determine if it had a function during an external event that was different from the function of the component for internal events. If there was a difference in function, the relative importance was determined by assessing the impact of failure of the component and the relative likelihood of the external events." The following are staff comments on this process:

a. The above analysis, by itself, might not be sufficient because:

(i) External events could result in plant initiators (e.g., LOCAs from spurious open PORVs, seal LOCAs, LOSP or SBO, etc.) that could result in relative importances of SSCs being changed. That is, since external events (especially for fires) may contribute significantly to the internal events CDF, the initiating events they result in could cause a relative shift in the overall initiator mix. Consequently, the relative importances of systems/components depended upon for accident mitigation will also change.

(ii) Spatially dependent CCFs which are unique to the external event initiators cannot be taken into account in the simplified analysis.

(iii) The loss of one train of one or more systems (for example, from the loss of one electrical division) from these initiators could cause the relative importances of components in the other train to be changed.

(iv) Components lost as a result of the external event are likely not to be recoverable.

Based on the above, please justify your approach, or provide a revised assessment of the external event risk.

b. A preliminary review of the results in Appendix C of Enclosure 5 shows that there were no components that were re-ranked high because of external event initiators. Is this correct?

c. Does the expert panel contain members that are familiar with the seismic qualification of plant SSCs (for seismic risk) or members that are familiar with plant fire protection (safe shutdown analysis, Appendix R evaluation, etc), or are all insights from the external events evaluation provided by the PRA/IPEEE engineer?

PRA-10
Shutdown risk ranking: The submittal stated that "IST valves important to shutdown were identified by a qualitative review." (see E4-1)

a. Please provide the criteria used for this qualitative analysis.

b. For shutdown risk ranking, there has to be evidence that all shutdown modes and operations have been evaluated. Internal flooding from maintenance actions can also be important in this case. Risk from fire must also be investigated because of the removal of fire barriers during shutdown operations. Finally, one of the conclusions from the shutdown study at Surry (NUREG/CR-6144) is that the LERF risk is on the same order of magnitude as the risk at-power even though the CDF risk is an order of magnitude smaller since many shutdown operations are performed with the containment not intact. Please address the above in terms of your qualitative criteria.

PRA-11
Containment risk importance:

a. For LERF, please provide the PVNGS definition for "Large" and "Early." Please indicate which release categories in your level II study are included in the LERF definition.

b. Discuss how LERF is adequate to cover latent health risks from large, late releases.

c. Why is there a criterion for LERF RAW and not one for LERF F-V, i.e., why isn't LERF F-V used for ranking?

d. Are cutsets carried forward to the end of the Level II analysis (source term bins)? If not, how is the LERF RAW calculated?

e. What does a "yes" in the "Large Early Release RAW" column in Table 4 of Enclosure 5 signify? If this means that the LERF measure might be important, please provide the basis as to why many components with "yes" in this column are ranked low?

f. A review of Appendix C of Enclosure 4 shows that only four components (i.e., AFA-V079, AFB-V080, SPA-HV49A, and SPB-HV50A) have LERF RAW greater than 10. Of these, the first two were ranked high. Does this imply that only two valves are important to the LERF risk? Please clarify, and if applicable, point out any other components that might be important in terms of LERF.

g. The submittal stated that Level II results are dominated by SGTR (Section 5.4.5 of Enclosure 4). In the IST risk ranking, what considerations have been given to SGTR isolation?

h. Most containment isolation valves and all interfacing systems LOCA valves were ranked low either because of redundancy or low event frequency (when compared to SGTR). What is the LERF RAW for the containment isolation valves and the ISLOCA valves? Keeping in mind the defense-in-depth philosophy, shouldn't some of these valves be ranked high? Also, how will the ISLOCA initiating event frequency and the loss of containment isolation probability be affected by the proposed extended frequencies for low ranked valves (including the effects of potential common cause failures)?

<u>PRA-12</u>
Final ranking results:

a. Valves AFA-V137, AFB-V138, AFB-HV30, AFB-HV31, AFB-UV34, AFB-UV35, AFA-HV32, AFC-HV33, AFC-UV36 and AFA-UV37 were ranked as Low in Table C15 of Enclosure 4. The valves were re-ranked as high in Section 5.5.1 in the same enclosure. Please correct the inconsistency. Also, in regard to these valves, why are valves AFA-V015 and AFB-V024 ranked low when the companion valves AFA-V137 and AFB-V138 are re-ranked high?

b. The following valves had a final ranking of low even though quantitative and qualitative insights would indicate otherwise. Please provide justification for the low ranking.

Valve	Attributes which might justify a High Ranking	DWG
AFBV024	FV=0.002, RAW=8.97, LERF RAW = 4	13-M-AFP-001
AFBV025	FV=0.002, RAW=8.97, LERF RAW = 4	13-M-AFP-001
CHAHV0531	FV=0.0003, RAW=2.06, Shutdown risk=M, CCF RAW = 5	13-M-CHP-002
CHBHV0530	FV=0.0003, RAW=2.06, Shutdown risk=M, CCF RAW = 5	13-M-CHP-002
SIAHV0657	Shutdown risk=H	13-M-SIP-001
SIAHV0683	Shutdown risk=H	13-M-SIP-001
SIAHV0687	Shutdown risk=H	13-M-SIP-001
SIAHV0698	FV=0.005, RAW=4, Shutdown risk=H, CCF RAW=5	13-M-SIP-001
SIAV201	Shutdown risk=H	13-M-SIP-001
SIAV404	Shutdown risk=H, CCF RAW=4	13-M-SIP-001
SIAV424	Shutdown risk=H	13-M-SIP-001
SIAV434	Shutdown risk=H	13-M-SIP-001
SIAV435	Shutdown risk=H	13-M-SIP-001
SIAV451	Shutdown risk=H	13-M-SIP-001
SIAV470	Shutdown risk=H	13-M-SIP-001
SIAV476	RAW=2.24, Shutdown risk=H, CCF RAW=5	13-M-SIP-001
SIAV522	Shutdown risk=H	13-M-SIP-002
SIAV523	Shutdown risk=H	13-M-SIP-002
SIAV957	Shutdown risk=H	13-M-SIP-002
SIBHV658	Shutdown risk=H	13-M-SIP-001
SIBHV692	Shutdown risk=H	13-M-SIP-001
SIBHV695	Shutdown risk=H	13-M-SIP-001
SIBHV0699	FV=0.005, RAW=4, Shutdown risk=H, CCF RAW=9	13-M-SIP-001
SIBV200	Shutdown risk=H	13-M-SIP-001
SIBV402	Shutdown risk=H	13-M-SIP-001
SIBV405	Shutdown risk=H, CCF RAW=4	13-M-SIP-001
SIBV426	Shutdown risk=H	13-M-SIP-001
SIBV446	Shutdown risk=H	13-M-SIP-001
SIBV447	Shutdown risk=H	13-M-SIP-001
SIBV448	Shutdown risk=H	13-M-SIP-001
SIBV478	RAW=2.24, Shutdown risk=H, CCF RAW=5	13-M-SIP-001
SIBV532	Shutdown risk=H	13-M-SIP-002
SIBV533	Shutdown risk=H	13-M-SIP-002
SIBV958	Shutdown risk=H	13-M-SIP-002
SPAHV0049A	FV=0.0013, RAW=3.2, LERF RAW=50, CCF RAW=5	13-M-SPP-001
SPBHV0050A	FV=0.0013, RAW=3.2, LERF RAW=50, CCF RAW=5	13-M-SPP-001

E. Risk Metrics and Numerical Decision Criteria

PRA-13

A comparison of the PVNGS decision criteria to trial criteria being considered by the staff is as follows:

Palo Verde IST*				
	FV < 0.001	FV ≥ 0.001	FV ≥ 0.005	FV ≥ 0.01
RAW ≥ 10	H	H	H	H
RAW ≥ 5	M	M	M	H
RAW ≥ 2	M	M	M	H
RAW < 2	L	M	M	H

* Also, ranking is M if CCF RAW ≥ 5, and is H if CCF RAW ≥ 10

Staff Trial Criteria				
	FV < 0.001	FV ≥ 0.001	FV ≥ 0.005	FV ≥ 0.01
RAW ≥ 10	H	H	H	H
RAW ≥ 5	M	H	H	H
RAW ≥ 2	M	H	H	H
RAW < 2	L	M	H	H

Example Ranking Using Palo Verde IST Components

	Number of Components			
	High	Medium	Low	Total*
PVNGS Criteria	8 (1.3%)	39 (6.3%)	572 (92.4%)	619
Proposed Criteria	32 (5.2%)	15 (2.4%)	572 (92.4%)	619

* Total includes 172 IST components that are truncated in IPE and 350 IST components that are not modeled in the IPE. For the purposes of this comparison, these were added to the low category.

The above trial criteria is based on (i) the staff's belief that the components with RAW > 10 should be ranked high regardless of the F-V value; and (ii) a F-V > 0.001 would result in ranking results that are more stable when truncation levels in the range of 1E-9 or 1E-10 are used.

As can be seen above, the PVNGS criteria are similar to the trial NRC criteria (if we assume that the PVNGS medium's are ranked as high). If you adopt the staff criteria, the following 24 PVNGS components will be added to the high category (in terms of PRA ranking).

Component	Final Ranking by PVNGS Expert Panel		DWG
AFAV079	H		13-M-AFP-001
AFBV024	L		13-M-AFP-001
AFBV025	L		13-M-AFP-001
AFBV080	H		13-M-AFP-001
AFBV138	H	originally ranked L but re-ranked H in Section 5.5.1 in Enclosure 4	13-M-AFP-001
AFAHV0054	H		13-M-AFP-001
SGAUV0134A	H		13-M-SGP-001
SGAUV0138A	H		13-M-SGP-001
SIAUV0617	H		13-M-SIP-002
SIAUV0627	H		13-M-SIP-002
SIAUV0637	H		13-M-SIP-002
SIAUV0647	H		13-M-SIP-002
SIBUV0616	H		13-M-SIP-002
SIBUV0626	H		13-M-SIP-002
SIBUV0636	H		13-M-SIP-002
SIBUV0646	H		13-M-SIP-002
SPAHV0049A	L		13-M-SPP-001
SPBHV0050A	L		13-M-SPP-001
SIAHV0698	L		13-M-SIP-001
SIBHV0699	L		13-M-SIP-001
SIAHV0604	H		13-M-SIP-001
SIBHV0609	H		13-M-SIP-001
SICHV0321	H		13-M-SIP-002
SIDHV0331	H		13-M-SIP-002

As can be seen above, of the 24 new "high" components, 18 were already ranked as high by the PVNGS expert panel. The remaining six that were ranked low are also present in the "inconsistent" list provided in comment PRA-12b and should therefore also be ranked high based on other considerations. Please justify the PVNGS criteria or justify why any of the above 24 components should be ranked as low. (see E1-2 and E5-5)

PRA-14
Another potential risk-ranking approach that we have given some consideration to is shown in the plot of Figure 2. Some typical basic event data are shown plotted as Fussell-Vesely importance ranking vs Birnbaum ranking. The data points are shown in some tentative quadrants, Hi-Hi, Lo-Lo, Hi-Lo, etc. Would the Expert Panel gain any useful insights by evaluating such a plot? Would it have any significant effect on the ranking results?

F. Sensitivity Studies

PRA-15
Effect of initiating events on ranking: Detailed modeling of initiating events (to the component level) is generally required to properly rank components. Representing initiating events (especially those caused by the loss of support systems) by single frequency numbers (black box model, modules, etc.) will result in inaccurate rankings for components within

support systems and balance-of-plant components. The PVNGS IST submittal (Section 4.1.3.3) followed a slightly different strategy in that it looked for "those components whose failure would directly cause an initiating event and those components whose failure could cause a complicated initiating event without operator action to prevent the event." These components would be ranked high unless the failure probabilities were extremely low.

a. A review of Appendix C of Enclosure 4 shows that there were no components that were ranked above a "low" in the "IE" column. Does this mean that the failure of all components which could result in a plant initiator was either easily recoverable by operator actions or was very low in frequency? Please list, by component, the HEP or the failure probability of components which might result in plant transients?

b. Please justify why the lack of detailed modeling of plant initiators (for example using fault tree models) will not impact the component rankings of the support systems involved.

c. How has the loss of balance-of-plant systems (like MFW and condensate) been considered in terms of initiating events? How does this affect the IST ranking of BOP valves?

PRA-16
Effect of CCFs: PRA ranking should assure that (a) ranking of components in the low category is not the result of lack of or low estimates for CCF contributions; and (b) the ranking and categorization are robust against the uncertainties associated with CCF contributions. This issue can be addressed first by re-examining the CCF rates for the low category components to make

sure the PRA assumptions are valid, and secondly by setting all CCF rates to zero and investigating which low category components may become important.

In the PVNGS submittal (Section 4.2.1), a study was done (by calculating CCF RAW) to determine the effects of having CCF rates that might be too low. However, the second part of the sensitivity study is not addressed. This would involve setting all CCF rates to zero and investigating which low category components may become important. In this way, components where CCF was not modeled will not be masked by those where CCF might dominate. Also, components that were ranked low because CCF was not included in the PRA model would be revealed. Please provide this second sensitivity study so that there could be assurances that the assumption of no CCF for certain components will not affect ranking. Also, please address the fact that the assumption of no CCF for certain components is still valid, even with extended IST frequencies.

PRA-17
Effect of human recovery actions: Large uncertainties associated with recovery actions, and the non-uniform application of recovery actions (which are usually applied only for the dominant sequences) can mask out the importance of some components. The issue can be addressed by performing ranking with and without recovery actions. The submittal (Section 5.4.6.2) stated that there are plans to perform this sensitivity study before implementation of risk based IST program. When will this be completed? Please make available the results of this study for NRC review.

PRA-18
Multiple component importance: There has to be assurance that the aggregate effect of components that are ranked low cannot impact risk significantly as a result of relaxing requirements. Two approaches were identified by the staff to study the potential effects of the failure of a group of components: first, to examine those minimal cutsets containing two or more components belonging to the low category, and secondly, performing sensitivity analyses by increasing the failure rates of components in the low category to identify those sequences and minimal cutsets that are most affected.

The submittal (Section 5.4.6.4) stated that no plant specific study on the effect of multiple component failures has been done to date. In a joint effort with Comanche Peak, PVNGS wants to study CPSES results to see if this is an important issue. If important, PVNGS plans to perform this sensitivity study before implementation of the risk-based IST program. How does PVNGS plan to justify that the CPSES comparison is valid since multiple component considerations are very configuration specific (and thus, plant specific)?

PRA-19
Ranking from dynamic plant configurations: An evaluation should be made to determine the impact on ranking if the static PRA is modeled to reflect the on-line maintenance strategies. It is expected that some components that are ranked low in the static model be shifted to the high category for specific

maintenance states. The areas where this might be important are periods where there are scheduled maintenance or rolling maintenance when pre-specified sets of components are brought down for maintenance for a pre-specified amount of time.

The submittal (Section 5.4.6.5) states that PVNGS plans to perform a sensitivity study for the 12-week maintenance schedule before implementation of RB IST program. When will this be completed? Please make available the results of this study for NRC review.

PRA-20
PRA Uncertainty: One of the ways to check for uncertainty effects is to identify the major uncertainties in the PRA and to evaluate the effects on the risk importance. The evaluations can be qualitative or quantitative. The PRA modeling effects on risk importance evaluations can be evaluated by using sensitivity calculations (like those proposed above). The effects of PRA data uncertainties can be evaluated by carrying out uncertainty propagation for selected risk importance values. An importance analysis using the fifth and ninety-fifth percentile of the unavailability distributions could be performed to determine the range of variations in F-V measures. Ranking of some components with large uncertainties (such as check valves) could vary and these components should be ranked in the higher category to account for the uncertainty distribution. Please describe how uncertainty has been addressed in the PVNGS risk ranking process.

G. Verification and Validation Cases

PRA-21
A calculation was performed to determine the increase in CDF due to the increase in failure probabilities of LSSCs. CDF, LERF and public consequences were re-calculated using the increased failure probabilities.

It is not documented how the sensitivity calculation was performed, whether or not the core damage cutsets were re-generated with the modified basic event probabilities. If the cutsets were not regenerated, serious numerical errors could occur. The main reason is that the base case core damage cutsets were generated with a truncation limit of 1E-9, and those basic events with F-V less than 0.001 may have barely survived the truncation. If a lower truncation were used, many additional cutsets and basic events would have appeared. These additional cutsets constitute the error due to non-re-generation of the cutsets. Please provide evaluation details on this V&V study.

PRA-22
In the V&V sensitivity study, the test interval was varied; however, the failure rate was left constant. Given the fact that the study increased test intervals by factors of up to sixty, it is very hard to postulate that the failure rate would stay constant. [Data that are available are based on the current test intervals, i.e., 3 months, 1 year, or maybe 18 months. Therefore, to apply the current failure rates for test intervals of up to 6 years is not justified.] The staff does not have confidence that constant

failure rates would be valid for the test intervals proposed in the submittal. It would be logical to assume that after a certain time period the effects of aging, corrosion, material deposition etc., will result in an increase in component failure rates.

PRA-23
The V&V results are based solely on increases in the internal event initiators. How would this increase be affected when external events and shutdown risks are included?

PRA-24
Does V&V include the potential increase in initiating event frequencies for the failure of support systems and components that are ranked as LSSC?

H. General Questions / Points for Clarification

PRA-25
In the summary and conclusions, a statement was made that "results ...[were] found to be safety neutral by an evaluation of cumulative effects." The staff does not necessarily consider increases in CDF by 8 percent and LERF by 18 percent to be safety neutral even though these small changes are likely within the bounds of the uncertainty for the analyses. A statement was also made that the risk based IST program "can be achieved while maintaining or even improving plant safety." However, the only "improvement" that is listed in the submittal (Enclosure 5, Table 3) is the identification of a non-IST valve AFNV012 as MSSC. This AFW discharge check valve will be verified to be closed once every shift by checking the temperature of the piping between the pump and the valve. This "testing" is currently done, and credit for this action is apparently already taken in the IPE since steam binding of the non-class AFW pump is not a dominant failure mode. Therefore "improving plant safety" as a result of the IST risk based program is misleading.

In summary, the staff does not believe that the above statements on risk neutrality and improvement of plant safety are appropriate unless you can quantify this risk decrease.

PRA-26
Table B2 of Enclosure 4 lists the Maintenance Rule low risk significant systems. Because the systems are ranked low, components within these systems are also ranked low for the IST risk ranking. Please address the following concerns:

a. The feedwater, condensate, and instrument & service air systems contain components that are potential plant trip initiators. Please justify how all components in these systems are ranked low.

b. The control building HVAC is ranked low. Please address the effects of the loss of control room HVAC on equipment operation and on operator action.

c. The containment isolation system is ranked low. However, failure of containment isolation will result in a significant increase in LERF. Please justify why containment isolation valves can be ranked low.

PRA-27

In Table D2 of Enclosure 4, "Changes to Basic Event Probabilities," please address the following apparent inconsistencies:

a. For valve AFAV007, the tabulated increase was by a factor of 36. Increasing frequency from quarterly to 3 years should only increase probability by 12.

b. For valves CHAHV531 and CHBHV530, the test interval was listed as four months. Table 2 of Enclosure 5 lists this interval as 18 months (CSD).

c. For valve SGAUV500P, the probability included the impact from the 500Q valve. How about the impact from the 500S and the 500R valves?

PRA-28

In Table D3 of Enclosure 4, "Changes to Unavailabilities for Alternate Test Intervals," the unavailabilities for valves AFAB015, AFBV024, SIBV405, and SIAV404 appear to be slightly in error. According to our calculations, these unavailabilities should be 7.88E-2, 1.18E-1, 1.58E-1, and 1.97E-1 for the 6-year, 9-year, 12-year, and 15-year intervals, respectively. Please justify or make the appropriate corrections.

Attachment: Figure 1/Figure 2

Figure 1 PLOT OF RISK ACHIEVEMENT WORTH VS. FUSSELL-VESELY WORTH FOR A TYPICAL PLANT SHOWING LARGE NUMBERS OF COMPONENTS THAT DO NOT CLEARLY FALL INTO A SPECIFIC RANKING CATEGORY

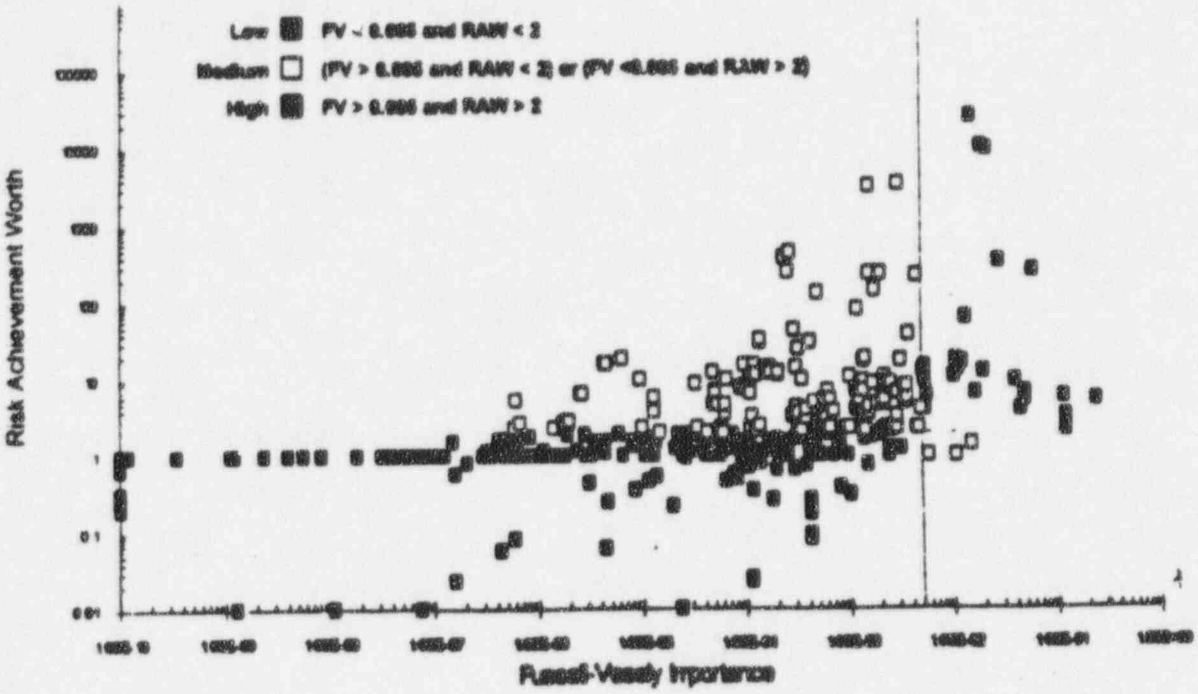
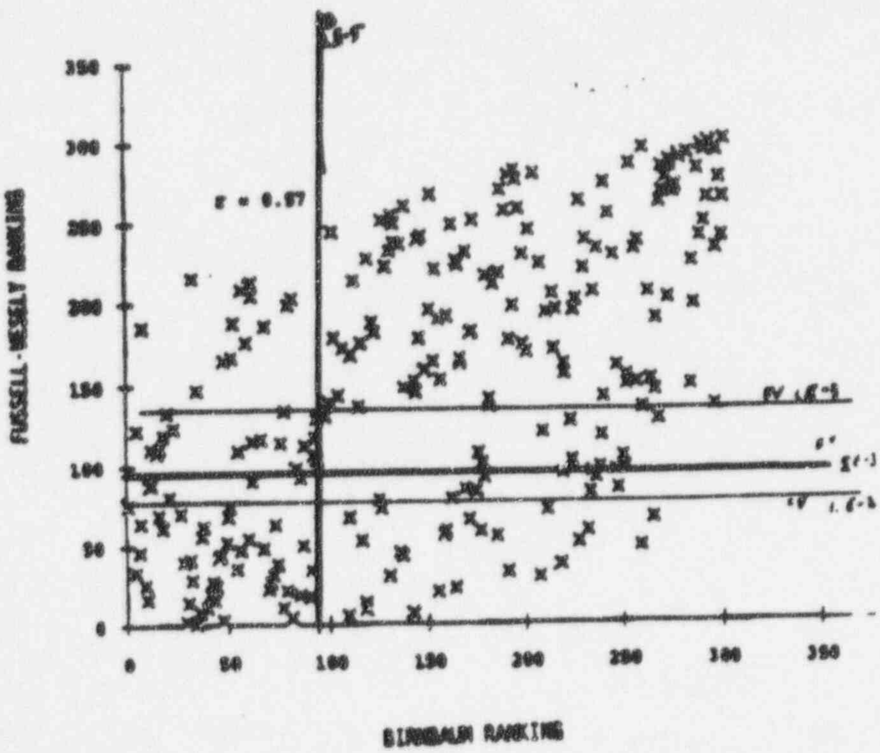


Figure 2 FOUR-QUADRANT SCHEME FOR RANKING BASIC EVENTS BASED ON A PLOT OF FUSSELL-VESELY RANKING VS BIRNBAUM RANKING



Although separate comments and RAIs are attached for each pilot-plant licensee, the staff has provided each licensee with both sets of comments and RAIs. The licensees have collaborated with each other and with NEI in developing their applications. While the two sets of comments and RAIs may differ, the staff's intention is to be consistent on all of the technical and policy issues. Any perceived differences identified by the licensees should be brought to the staff's attention as soon as possible for clarification.

The staff would like to meet with each pilot-plant licensee within a few weeks after transmittal of the comments and questions to the licensees and before the licensees prepare written responses to these comments and questions. Based on information that the licensees provide to the staff at these public meetings, the staff will, to the extent practicable, identify those questions and comments for which written responses are not expected of the licensees.

The staff appreciates the licensees' willingness to work with the NRC to help define methods and criteria necessary to produce acceptable risk-informed IST programs at the pilot-plant sites. The staff's interactions with the pilot-plant licensees will be instrumental in helping the staff develop regulatory guidance that can also be used by other licensees to produce safe and more cost-effective IST programs.

The requirements affect nine or fewer respondents and, therefore, are not subject to the Office of Management and Budget review under P.L. 96-511. If you have any questions, please contact me at 301-415-1330.

Sincerely,

Original signed by:
Timothy J. Polich, Project Manager
Project Directorate IV-1
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket Nos. 50-445 and 50-446

Enclosures:
1. Comanche Peak Request for Additional Information
2. Palo Verde Request for Additional Information

cc w/encls: See next page

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