December 2, 1997

Mr. J. V. Parrish
Chief Executive Officer
Washington Public Power Supply System
P.O. Box 968 (Mail Drop 1023)
Richland, Washington 99352-0968

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE WASHINGTON PUBLIC POWER SUPPLY SYSTEM (WPPSS) NUCLEAR PROJECT NO. 2 (WNP-2) (TAC NO. M83695)

Dear Mr. Parrish:

The staff has reviewed your letters dated December 18, 1991, and June 26, 1995 which were submitted in response to Generic Letter 88-20, Supplement 4, "Individual Plant Examination for External Events," dated June 28, 1991. Based on the review, the staff has determined that the additional information identified in the enclosure is needed to complete the review. In order to maintain our review schedule, we request that you please provide a response to the enclosed questions within 60 days of receipt of this letter.

If you have any questions, please contact me at (301) 415-1362.

Sincerely,

Original Signed By

Chester Poslusny, Senior Project Manager
Project Directorate IV-2
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-397

Enclosure: Request For Additional Information

cc w/encl: See next page

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REQUEST FOR ADDITIONAL INFORMATION

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

WNP-2

DOCKET NO. 50-397

INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)

Fire

1. A qualitative screening criteria was used to eliminate some fire areas from further analysis. The wording for this criteria (on page 4.0-21) implies that an area can be screened if it contains no safety-related components, no associated cables for those components, and no cables/components whose failure would cause a plant scram (i.e., all three conditions would have to be met to screen out an area).

   Two fire areas screened from further analysis based on this criteria are DG-6, the high pressure core spray (HPCS) diesel generator oil pump room and DG-7, the HPCS day tank room. Since the HPCS diesel generator is required to mitigate a station blackout and the HPCS diesel generator room is not screened out, provide justification for screening these two areas according to the above criteria.

2. It is important that the human error probabilities (HEPs) used in the screening phase of the analysis properly reflect the potential effects of fire (e.g., smoke, heat, loss of lighting, and poor communication), even if these effects do not directly cause equipment damage in the scenarios being analyzed. If these effects are not treated, the HEPs may be optimistic and result in the improper screening of scenarios. Note that HEPs which are conservative with respect to an internal events analysis could be non-conservative with respect to a fire risk analysis.

   Please identify: a) the scenarios screened out from further analysis whose quantification involved one or more HEPs, b) the HEPs (descriptions and numerical values) for each of these scenarios, and c) how the effects (e.g., smoke, heat, loss of lighting, and poor communication) of the postulated fires on HEPs were treated.

3. The revised core damage frequency (CDF) values for most of the 16 unscreened fire zones appear to be less than the minimum value possible when the stated recovery or reduction factors are applied. For example, a recovery factor of 0.06 was applied to the screening CDF value for switchgear room 1 (3.57E-5/yr). If this recovery factor were applicable to all the cutsets for this fire area, the minimum CDF would be 0.06*3.57E-5/yr or 2.14E-6/yr. However, the reported CDF is 1.29E-7/yr.

   Please explain this discrepancy.

4. From the submittal it can be inferred that the licensee has not considered hot shorts as a failure mode for control or instrumentation cables. In particular, hot short considerations should include the treatment of conductor to conductor shorts within a given cable. Hot shorts in control cables can simulate the closing of control switches leading, for example, to the repositioning of valves, spurious operation of motors and pumps, or the shutdown of operating equipment. These types of faults might, for example, lead to a loss of coolant accident (LOCA), diversion of flow within various plant systems, deadheading and failure of important pumps, premature or undesirable switching of pump suction sources, or undesirable equipment operations. For main control room (MCR) abandonment scenarios, such spurious operations and actions may not be indicated at the remote shutdown panel(s), may not be directly recoverable from remote shutdown locations, or may lead to the loss of remote shutdown capability (e.g., through loss of remote shutdown panel power sources). In instrumentation circuits hot shorts may cause misleading plant readings potentially leading to inappropriate control actions or generation of actuation signals for emergency safeguard features.

   Discuss to what extent these issues have been considered in the IPEEE. If they have not been considered, please provide an assessment of how inclusion of potential hot shorts would impact the quantification of fire risk scenarios in the IPEEE.

5. The submittal is unclear on the credit given for Thermo-Lag and penetration seals in preventing fire propagation. The submittal indicates on page 4.0-58 that both Thermo-Lag raceway enclosures and all fire-rated penetration enclosures have been declared inoperable. However, the submittal also indicates on page 4.0-23 that a fire is assumed contained by fire barriers including penetration seals.

   Address these contradictory statements concerning penetration seals. Also indicate if any credit was given for Thermo-Lag for preventing fire damage or propagation in the fire assessment.

6. In the IPEEE submittal it is stated that COMPBRN modeling results have been used to justify partitioning of the reactor building into various fire zones for analysis. In particular, simulations involved two 55 gallon drums of oil as a fire source, and based on hot layer temperature predictions, the area was partitioned. The described analyses appear to represent an application of COMPBRN that is well beyond its capabilities. COMPBRN uses a quasi-steady-state model of hot layer development that assumes instantaneous spread of the hot layer throughout the enclosure. During a fire in a very large enclosure, the assumption of a uniform hot layer forming throughout the area is not representative. For such scenarios, there would be a prolonged period (up to several minutes in duration) of transient fire plume/ceiling jet/hot layer development before a quasi-steady condition would develop. COMPBRN is not intended to predict localized effects that would dominate the fire scenario during this period. While partitioning of very large

fire areas into smaller zones for analysis is, in principal, an acceptable PRA approach, citing COMPBRN hot layer predictions as the basis for this is not appropriate.

Please provide a further justification for partitioning of the reactor building into fire zones that includes consideration of (1) the location of fire sources relative to both other in-situ and transient combustibles and the potential for the source/exposure fire to spread to these fuels, (2) proximity of the fire to risk-important thermal targets and the potential for plume, ceiling jet, and radiant heating effects to cause damage to critical targets, (3) the general arrangement of combustibles in the area and the potential fire spread paths especially if they present a potential for spread from zone to zone, and (4) any localized partitioning of the area (such as partial walls, significant ceiling level obstructions, etc.) consistent with these factors.

Seismic

1. In Figure 3.1-2 of the submittal, mean hazard curves are provided. The calculated mean hazard curves appear to be much closer to the median curve rather than the 84th percentile of the hazard distribution. It seems the standard procedure of estimating the "mean hazard" (i.e., averaging exceedance probabilities given a fixed acceleration value) was not followed in the analysis. Please explain how the mean hazard curves were calculated. Also, explain how and where these hazard curves were used in the seismic analysis (e.g., in developing the screening criteria).

2. In Section 3.2.4 of the submittal, it is stated that the seismic walkdowns were used for component screening. However, the screening criteria, as well as a list of the screened components, are not included in the submittal. Please provide a description of the screening criteria used during the walkdowns, and the list of screened components together with the rationale for each component screened out.

3. In Section 1.4.1 of the submittal, it is stated that "a new probabilistic soil-structure interaction analysis was performed in conjunction with the seismic IPEEE study." Also Section 3.3.2 states, "comparisons of the 0.5g median probabilistic floor spectra to the original design floor response spectra for the safe shutdown earthquake (SSE) reveals that they are comparable." No further descriptions of the floor spectra (new or old) are provided in the submittal, although the newly obtained floor spectra were used extensively in developing the generic screening criteria for components. Please provide the actual comparisons of new and old floor spectra for each floor level.

4. In Section 3.3.1 of the submittal, the high-confidence, low probability-of-failure (HCLPF) capacities of civil structures are estimated based on the Electric Power Research Institute (EPRI) conservative deterministic failure margin (CDFM) method. As described in the submittal, the calculated HCLPF capacities of many critical components were very close

to the screening criterion value of 0.5g. To confirm the validity of the screening performed, please provide the submittal's Reference 3.6.5 on the fragility analysis of civil structures.

5. Section 3.4 of the submittal describes the generic screening criteria for flexible equipment and distribution systems. From the description in the submittal, it appears that several optimistic assumptions were used. The following specific questions relate to the development of generic screening criteria:

   a. In the estimation of the strength factor Fs = 2.49, the following ratios are assumed in the analysis:

      Median strength/code ultimate strength = 1.2;
      Code allowable/code ultimate strength = 0.7; and
      Average demand/code allowable = 0.7.

      Please provide the basis of the above ratios, such as available statistical data or past studies in this area, using a few examples. Also, explain the technical definitions of "average demand" and "code ultimate strength."

   b. Explain why the response factor of F_{RE} = 1.28 was used when the median-centered floor spectra were used as the reference input for equipment.

   c. On page 3.0-34 of the submittal, the strength factor, Fs, was estimated as a ratio of the ultimate strength to the design SSE. However, on page 3.0-36, the SSE multiplier (0.25g) was replaced by the reference median-centered ground acceleration of 0.5g in calculating the median fragility value of 1.57g. Please explain the reasoning for this assumption.

   d. A relatively narrow frequency range of 5 - 10 Hz was used as part of the definition of the "flexible equipment." Please explain how this criterion was implemented to classify a large number of components and equipment into the category of the "flexible equipment."

6. On page 3.0-37 of the submittal, a median fragility value of 1.05g was estimated for rigid equipment. Please explain the assumptions and technical bases for this calculation.

7. Only three initiating events were considered in the seismic analysis. Boiling water reactor (BWR) initiators, which are usually considered in other studies (e.g., a large LOCA due to recirculation piping/pump support failure and a stuck open safety relief valve (SRV)) were not discussed in the submittal. Also, a few initiators identified in the IPE study as having a high conditional core damage probability (e.g., a loss of service water (SW), a steamline break outside containment, a loss of DC, or flooding) were either not discussed in the IPEEE

submittal, or a statement was made that the effects of a loss of offsite power (LOOP) envelop the effects of these initiators. However, a LOOP is "recoverable" via diesel generators, whereas seismically induced failures of other systems generally are not recoverable. Please discuss and justify the screening of such initiators in more detail.

8. For systems in which all components are screened out, a "surrogate" component is inputted into the fault trees to represent seismic failures of the system. This surrogate component can mask contributions to seismic failures from different components and systems in that it fails at the same time in all the systems' fault trees where it appears. How did the analysis assure that the screening process did not significantly understate system failure probability in systems where multiple-input OR gates are used to combine screened component failure probabilities, and at acceleration levels of interest? The fact that the failure probability of the system above an OR gate should be greater than that of any of the components feeding into the OR gate could be erroneously ignored during the combination process.

   According to Figure 3.5-2 of the submittal, the sequence ESS07 consists of a small LOCA initiator and the failure of all screened equipment. It appears that both top events were represented by a surrogate element. Please explain how the multiple failures of surrogate elements within an accident sequence were treated in the risk quantification (e.g., correlation of failures).

9. The treatment of correlated failures in the analysis is not clear from the submittal. In one instance (loss of switchgear cooling motor control centers (MCCs)), a perfect correlation is assumed. No further discussion is found on this subject in the submittal. Please explain how the correlation between component failures was treated in the risk quantification.

10. The submittal indicates that random failures of components contributed measurably to core damage. Random failures were taken from the model and assigned an error factor of 10. The submittal states that a sensitivity study was performed on this factor. By reducing the factor from 10 to 3 the calculated mean CDF value was reduced by 40 percent. Please explain why the reported analysis results are so sensitive to the error factors of the random failure probabilities.

11. There is little discussion on the submittal on how building failures may contribute to component failures (and initiating events), other than the fact that most such failures were screened out. This would also include the effect of relative building motion on piping failures. Please discuss if and how screened structures (buildings, tanks) were included in the fault trees. Is the relative motion between buildings included in the pipe failure analysis? If it is not, please justify this omission.

12. Please explain why the Fussell-Vesely importance of the seismically induced switchyard failure is so low. It would seem that the switchyard failure would accompany other initiating events due to the fragility of the ceramic insulators.

<u>High Wind, Flood and Other External Events (HFO)</u>

1. Section 5.2.3 "Determine if the Plant/Facilities Design Meets 1975 Standard Review Plan (SRP) Criteria" of NUREG-1407 states that "All licensees should compare the information obtained from the review discussed in Sections 5.2.1 and 5.2.2 for conformance to 1975 SRP and perform a confirmatory walkdown of the plant. The walkdown would concentrate on outdoor facilities that could be affected by high winds, onsite storage of hazardous materials, and offsite developments. If the comparison indicates that the plant conforms to the 1975 SRP criteria and the walkdown reveals no potential vulnerabilities not included in the original design basis analysis, it is judged that the contribution from that hazard to core damage frequency is less than 10^{-6} per year and the IPEEE screening criterion is met."

   Please provide a summary of the findings of a confirmatory HFO walkdown and resolution of any identified potential vulnerabilities. If a confirmatory HFO walkdown was not performed, please provide justification for not performing the walkdown and describe your rationale for not missing any potential vulnerabilities which could be identified during a walkdown.