June 14, 1996

Mr. Richard W. Smedley
Manager, Licensing
Palisades Plant
27780 Blue Star Memorial Highway
Covert, MI 49043

SUBJECT: PALISADES PLANT - REQUEST FOR ADDITIONAL INFORMATION REGARDING THE RESPONSE TO GENERIC LETTER 88-20, SUPPLEMENT 4, INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (TAC NO. M83653)

Dear Mr. Smedley:

By letter dated June 30, 1995, you submitted your response to Generic Letter 88-20, Supplement 4, Individual Plant Examination of External Events. The staff has reviewed your submittal and has determined that additional information is required to complete our review. Please provide a response to the enclosed questions within 60 days of the date of this letter. If you have any questions regarding this request, please contact me at 415-1312.

Sincerely,

Original Signed By:

Robert G. Schaaf, Project Manager
Project Directorate III-1
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure: Request for Additional Information

cc w/encl: See next page

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WASHINGTON, D.C. 20555-0001

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PALISADES PLANT
DOCKET NO. 50-255
REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE RESPONSE TO GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS

A. Seismic

1. Please provide (in a table) a complete list of anomalous conditions and outliers observed in the seismic walkdowns of all SPRA (seismic probabilistic risk assessment) equipment (including walkdowns for seismic-induced fires and floods). Anomalous conditions include anchorage concerns, interaction concerns, functional concerns, construction-adequacy concerns, seismic housekeeping concerns, etc. Please discuss the resolution of each of these items, noting any relevant plant improvements or analyses, and summarize their disposition status.

2. Table 3.5-1 lists only those SPRA components that did not screen out at 0.5g PGA (peak ground acceleration) HCLPF (high confidence of low probability of failure). In other words, the list excluded those components represented by means of the surrogate element. Please provide a list of all components that were addressed in plant seismic walkdowns, including those screened out at 0.5g PGA HCLPF. The result should be a complete table of all SPRA components. In this table, indicate which components were screened out at a HCLPF level of 0.5g PGA (i.e., those components represented by the surrogate element).

3. Crude fragility assignments based on a 0.10g PGA HCLPF were made for a number of components in the SPRA. Some of the components modeled in this way are important to the overall plant capacity. Thus, calculations of actual HCLPF capacities for these components may reveal that the plant HCLPF is less than the reported value of 0.22g. In addition, NUREG-1407 guidelines specify that fragilities "should be plant specific and rigorous to be able to identify dominant components and rank them."

   Please provide fragility calculation results for all components that were not screened out (i.e., for those components simply assigned a HCLPF capacity of 0.10g PGA) and for any additional components that have an important contribution to seismic core damage frequency (which may include some components screened out at a 0.3g PGA HCLPF level). Please modify Table 3.5-1 based on these calculations, and indicate in the table whether detailed or simplified fragility calculations were conducted. Please also modify Table 3.5-1 to show fragility parameters (median, β_c, HCLPF) for all components that were not screened out at 0.5g. (Please ensure that Table 3.5-1 is complete. For instance, it currently appears to be missing a fragility for loss-of-offsite power. In addition, no instance of a "simplified" fragility is cited in the table, even though the submittal mentions that simplified fragility analysis has been employed. Also, the current table does not present fragility parameters produced from the detailed fragility calculations.) Please provide requantified accident sequence frequencies and seismic

CDF (core damage frequency), using these refined fragilities, and a reassessment of the dominant risk contributors.

4. Please report the percent contribution to the seismic CDF that is due to failure of the surrogate element. Discuss the expected changes in the seismic CDF and in the failure contribution of the surrogate element if a separate surrogate element failure event were to be included (as an element in series with existing system fault tree logic) for each system in the SPRA model.

5. The submittal simply notes that seismic initiators/events, other than small break loss-of-coolant accident, loss-of-offsite power, and turbine building fires and floods, were screened out based on low (yet unreported) probabilities of occurrence. Please provide the screening values and their bases that were used to exclude other potential seismic initiators/events that may be modeled in an SPRA. Describe the basis for assessing the bounding probabilities of occurrence for each initiator, and discuss any insights related to the conditional probabilities of core damage given occurrence of each of these events.

6. Please describe how the time history was generated for obtaining input for the soil-structure interaction analyses. Provide the following: (a) a plot of the acceleration time history; (b) a plot of the power spectrum of the time history; and (c) a plot of the response spectrum of the time history as compared to the target response spectrum.

7. Please provide a discussion of the treatment of mission times, failure dependencies (e.g., of similar, co-located equipment), and of other inter-related failure effects (that are not discussed in the IPEEE report) within the SPRA model. What are the relevant numerical values used in the analysis pertaining to these effects? How were these values obtained, and how were they used in the SPRA model? What are their impacts on the SPRA results?

8. Please list the human actions modeled in the SPRA and their associated IPE human error probabilities and their seismic fragilities. Please indicate when and where each human action is required.

9. Please provide HCLPF calculations and results, completed screening evaluation work sheets (SEWSs), walkdown notes/checklists and photographs for the following SPRA-significant components:

- CST [Condensate Storage Tank]
- SIRWT [Safety Injection and Refueling Water Tank]
- Control Panel for Fire Pumps
- Diesel Day Tanks (T-24 and T-40) for Fire Pumps
- Block Walls Supporting the Diesel Day Tanks for the Fire Pumps
- Station Transformer 13
- MSIVs [Main Steam Isolation Valves]

- Diesel Generator (DG) Fuel Oil Tank (T-10)
- DG 1-2 Undervoltage

Please respond to question A.3 above before providing this information.

10. The submittal's discussion in the seismic-fire interactions evaluation does not adequately address the relevant concerns for seismic degradation of fire suppression systems. The discussion focuses only on potential interactions of FPS (fire protection system) components with essential equipment. The evaluation should also include an examination of potential loss of FPS capability itself due to seismic events, especially since credit for this system is taken in the SPRA model. Examples of items found in past studies include (but are not limited to):

    - Unanchored CO_2 tanks or bottles
    - Sprinkler standoffs penetrating suspended ceilings
    - Weak or unanchored 480V or 600V (nonsafety-related) electrical cabinets (as potential fire sources) in close proximity to essential safety equipment (e.g., cables in cable spreading room)
    - Fire pumps unanchored or on vibration isolation mounts
    - Mercury or "bad actors" relays in fire protection system (FPS) actuation circuitry
    - Use of cast iron fire mains to provide fire water to fire pumps

    NUREG-1407 suggests a walkdown as a means of identifying any such items.

    Please provide the results of your seismic-fire interaction study pertaining specifically to seismic degradation of FPS capability. Also, include the guidelines given to walkdown personnel for evaluating the foregoing issues (if they exist).

11. Please report the final plant HCLPF capacity after responding to the preceding questions. Include plots of the plant HCLPF spectrum and the SSE (safe shutdown earthquake) spectrum on the same graph. Please justify the spectral shape used for reporting the plant HCLPF spectrum.

B. Fire

1. The study assumed that only a single control room cabinet would be affected by a suppressed fire. In fact, it assumed a particular cabinet (C01) would be affected. It is typical for plants to have cabinets with open sides which would allow propagation of fire (or smoke) damage into another cabinet. This might occur before operators are able to act to suppress the fire. Control rooms are also susceptible to fires that start from other sources such as waste baskets and kitchen areas. Therefore, this assumption may actually underestimate core damage frequency. Furthermore, the assumption that C01 is the damaged cabinet only allows vulnerabilities to be discovered with respect to failures in

that cabinet. The state-of-the-art assessment process includes analysis of fires postulated to initiate from each fire source in the control room.

a. Please provide a discussion of the potential for inter-cabinet fire propagation owing to open-sided cabinets at Palisades before operators can suppress the fire.

b. Please provide a discussion of how the dominant sequences would be affected by assuming the fire initiates in other control room cabinets. For each cabinet in the control room, include a discussion of the equipment that is affected and the sequences that are most significant to the conditional core damage probability.

c. Similarly, please provide a discussion of the potential of fire growth from other fire sources in the control room area. Include the potential to propagate to overhead cables, computers, cabinets, and consoles. For each fire source in the control room, include a discussion of the equipment that is affected and the sequences that are most significant to the conditional core damage probability.

2. The probability of manual suppression before damage is a function of both the probability of fire damage, as a function of time, and the probability of successfully completing fire suppression activities which is also a function of time. For example, FIVE (fire induced vulnerability evaluation) methodology suggests that if a critical combustible loading is present, then the time to damage, t_{crit}, is calculated. The probability of non-suppression depends on the relationship between t_{crit} and the demonstrated fire brigade response and extinguishment times. In contrast, the study appears to simply have assigned a value of 0.01 for the probability of failure of manual suppression in the control room. Either (a) provide an explanation of the analysis performed to develop the control room manual non-suppression probability, and demonstrate that 0.01 is a realistic estimate, or (b) discuss the effect of using a more typical number (e.g., 0.1).

3. Sandia has performed experiments to investigate a reasonable range of times to operator abandonment of the control room. These indicate that poor visibility could force abandonment within 6 to 8 minutes from the time flame is visible in a cabinet. The Palisades IPEEE, however, simply assumed that unsuppressed fires would require abandonment and suppressed fires would not, without regard to timing. Please discuss how suppression will be achieved before operators would be forced to abandon the control room. What is the probability of suppression before abandonment? What is the probability that smoke will force abandonment even if suppression is successful?

4. The study assumed that any fire in the cable spreading and switchgear rooms would be limited to a single system, the auxiliary feedwater system, if suppression were successful. The assumption that only the

auxiliary feedwater is damaged limits discovery of vulnerabilities related to these failures. It is not obvious that this assumption is bounding. Please provide a discussion of how the dominant sequences would be affected by assuming the fire initiates in other fire sources (e.g., cabinets, MCCs (motor control centers), panels, motor generator sets). For each source in these rooms, include a discussion of the equipment that is affected and the sequences that are most significant to the conditional core damage probability.

5. Initiating events appear to be limited to transients with loss of the power conversion system. Loss-of-offsite power owing to turbine building or switchgear room fires has emerged as an important contributor in other studies but does not appear to have been considered in this study. The submittal claims that no fire initiator was identified that could credibly lead to a LOCA (loss-of-coolant accident). The process used to search for such initiators was not provided. Furthermore, the transient event tree used does not include transient induced LOCAs, such as a stuck-open relief valves. Although fire-induced hot shorts are typically unlikely to cause LOCAs, this potential was not mentioned in the submittal. Please,

   a. Discuss the potential for loss-of-offsite power to safe shutdown systems because of fires in the turbine building and auxiliary building.

   b. Discuss the potential for fires to create a LOCA (such as a stuck open relief valve), or interfacing LOCA (such as opening of shutdown cooling system isolation valves), particularly considering the potential of fire-induced hot shorts to initiate valve motion.

   c. Explain how transient-induced LOCAs, such as stuck open relief valves, are treated in the study. If they were not treated, discuss how the dominant sequences would be affected by including them.

6. The failure probability for automatic suppression used the FIVE values. This data is acceptable for systems that have been designed, installed, and maintained in accordance with appropriate industry standards, such as those published by the National Fire Protection Association. It is not clear that the assumption, used in the study, that automatic suppression is capable of limiting fires to a single system is conservative in all cases. Please,

   a. Describe the survey or walkdown that was performed to determine if sprinklers are installed in accordance with industry standards.

   b. Provide the estimates of delay time for sprinkler actuation and fire suppression in these areas.

   c. Describe the analyses or evaluations that determined that automatic suppression would limit damage to a single system (e.g., in the cable spreading room) or single power bus (e.g., in the switchgear rooms).

7. Although the IPEEE study recognized that operators may be required to abandon the control room because of a fire in the control room, it did not appear to recognize that they may have to abandon the control room because of a large fire in the cable spreading room which renders the controls in the control room inoperable. Please,

   a. Discuss how operators would respond to a fire in the cable spreading room that disables control of key safe shutdown functions from the control room.

   b. Describe the effect on the dominant sequences and core damage frequency owing to fires in the cable spreading room including the potential for operator abandonment of the control room.

8. The study assumed that fire barriers would always be effective, as rated, at limiting fires and smoke to a single area. However, it is not clear that the study considered active fire barriers (e.g., a normally open fire door closed by a fusible link, or a similarly actuated open damper). Please provide an analysis of the effects on the results (i.e., dominant sequences and dominant areas):

   a. if the potential for the failure of active barriers is considered in all areas, and

   b. if the potential for cross-zone fire propagation is considered for high hazard areas such as the turbine building, diesel generator room, switchgear rooms, and lube oil storage areas.

9. The submittal used the FIVE methodology and database for fire initiation frequencies but two areas were shown in the submittal with frequencies lower than the base frequencies found in Table 10.2 of the "Fire Induced Vulnerability Evaluation (FIVE) Methodology Plant Screening Guide," TR-100370, April 1992. The FIVE methodology would give an initiation rate of at least $3x10^{-2}$ per year for each diesel generator room. The submittal (Table 4.1.7.3) shows the frequency of each room as approximately $1.7x10^{-2}$ per year for each diesel generator room. Please provide the calculation details and explanation for the fire frequency in these areas.

10. Human actions are identified as important to core damage frequency estimates. However, no details are provided regarding how the human error probabilities were assessed. Please provide a description of how fire event recovery actions (e.g., control room abandonment and use of the alternate shutdown panel, local manual operation of auxiliary feedwater pumps, opening of atmospheric dump valves, initiation and control of once through cooling) were assessed. Include how factors such as timing and environmental stressors (e.g., reduced visibility, impaired communications, impaired accessibility) were considered. If

IPE values were used, how were they adjusted to reflect the fire-related environmental stressors? If IPE values were not adjusted, provide the rationale for not having adjusted the values.

11. The study stated on Page 4-7 that it used the FIVE method for screening out inter-zonal fire propagation. The control area is divided into three zones as described on Pages 4-17 and 4-18. It appears from Table 4.1.6.1 that each of these zones was retained for analysis and analyzed as individual zones without the potential for inter-zonal fire propagation. In view of the fact that 30% of the separating wall is ordinary glass, which does not constitute a fire barrier, please (a) explain why these zones were not considered as a single area in the analysis, and (b) discuss the effect on the results (e.g., dominant sequences and core damage frequency) of considering Zones 1A, 1B and 1C as a single entity.

12. Page 4-14, Assumption 1 states that an engineering analysis concluded that fire spread between the transformers and the turbine building is not credible. In light of the occurrence of such fires, and the obvious potential of fire spread between a large station power transformer and the turbine building, please provide the referenced analysis (Ref. 4-6 of the submittal).

cc:

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