February 23, 1990

Docket Nos. 50-275
and 50-323

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Mr. J. D. Shiffer, Vice President
Nuclear Power Generation
c/o Nuclear Power Generation, Licensing
Pacific Gas and Electric Company
77 Beale Street, Room 1451
San Francisco, California 94106

Dear Mr. Shiffer:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RELATING TO NRC STAFF REVIEW OF DIABLO CANYON LONG TERM SEISMIC PROGRAM (LTSP) (TAC NOS. 55305 AND 68049)

Enclosed is a request for additional information relating to LTSP geology, geophysics and seismology issues. This request has resulted from the review, by the NRC staff and its consultants, of PG&E presentations at recent technical meetings, written submittals, and information obtained as a result of the Loma Prieta earthquake.

As you know, we are planning to have a final meeting on LTSP geology and earthquake source characterization issues in mid-April, 1990. It is our intent to complete our review of these areas soon after that meeting. In order to assure that all outstanding issues can be covered at the April meeting, we request that you provide the additional information identified in the enclosure by March 31, 1990. We also request that you address all outstanding requests for additional information in the geoscience area, all the new information presented at the January 29-30, 1990 meeting, and all issues discussed at the January meeting by March 31, 1990.

If you have any questions regarding this request, please contact me.

Sincerely,

original signed by Harry Rood

Harry Rood, Senior Project Manager
Project Directorate V
Division of Reactor Projects - III,
IV, V and Special Projects
Office of Nuclear Reactor Regulation

Enclosures: as stated

cc w/encl: See next page

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

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As you know, we are planning to have a final meeting on LTSP geoscience issues in mid-April, 1990. It is our intent to complete our review of the geoscience area soon after that meeting. In order to assure that all outstanding issues can be covered at the April meeting, we request that you provide the additional information identified in the enclosure by March 31, 1990. We also request that you address all outstanding requests for additional information in the geoscience area, all the new information presented at the January 29-30, 1990 meeting, and all issues discussed at the January meeting by March 31, 1990.

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Office of Nuclear Reactor Regulation

Enclosures: as stated

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ENCLOSURE 1

REQUEST FOR ADDITIONAL GEOSCIENCE INFORMATION
DIABLO CANYON LONG TERM SEISMIC PROGRAM

1. In order to determine whether spectral averaging is masking source propagation and directivity effects that need to be accounted for, provide a table showing the peak ground acceleration and the average spectral acceleration in the 3 to 8.5 Hertz and 5 to 14 Hertz ranges for each component of ground motion at each station used for all of the LTSP Hosgri numerical modeling studies.

Questions two through seven are asked as a means of aiding in the review of the geophysical and geologic information and interpretations presented at the January 29-30, 1990 meeting in San Francisco.

2. The seismic velocity model used in the analysis of reflection seismology data may greatly influence the geological interpretation. Therefore, describe and analyze the methods used to derive the velocity model on which the depth sections shown in the montages were based. Of importance are the range of vertical and horizontal velocity gradients near the Hosgri fault zone and also those elsewhere in the offshore Santa Maria basin. Also, discuss the degree of sensitivity of the geologic interpretation of the seismic data (e.g. dip of fault, earthquake potential) to the likely variations in the velocity model used.

3. Because new processing has been applied to the seismic reflection lines in the montages, show side-by-side the uninterpreted, reprocessed time sections for GSI lines 85, 86, 101, 103, and 106 and the same uninterpreted lines as they were processed for the LTSP final report. For reference, also display, at the same horizontal and vertical scales the time sections of the original 1980 processing by Geocenter, Houston. For line GSI 103, which was not shown on the montage, make the comparison with line PG&E 3, which was shown.

4. Gas-charged sediment appears to be present on many seismic reflection lines shown in the montages. Evaluate the effect of gas-charged sediment on the interpretations shown for the Hosgri fault zone. Particularly address the hypothesis that the area interpreted by PG&E as the vertical Hosgri fault is a gas-charged zone and not a fault.

5. During the discussion of the question of the possibility of strike slip motion on a non-vertical fault at the meeting it was noted that, there is at least one example, the Xieshi He fault zone in China, of a moderately dipping fault which accommodated reverse displacement in early Quaternary time and has more recently been reactivated as a strike-slip fault. Are there many cases of moderately dipping active strike-slip faults? Is there any evidence for this type of history for the Hosgri fault? What impact would this have on the resultant source characterization and ground motion for Diablo Canyon? (Dipping strike-slip faults have been previously identified as causes of high ground motion.)

6. We were informed during the January meeting that the drilling log of an oil exploration well, which is located in the vicinity of the PG&E cross section T-T', has recently become available. The information contained in this log should be incorporated into the interpretation of the nearby seismic reflection lines. What is the impact of this information upon previous interpretations?

7. We have seen on various maps, cross sections, and montages, that to the east of the Hosgri fault zone compressional features such as the Los Osos fault, the Pecho fault, and the Casmalia fault have strikes which make angles of about 40 to 60 degrees with the strike of the Hosgri, indicating a northeast-southwest horizontal compression. West of the Hosgri the major compressional features (folds and thrust faults) have strikes that are parallel to the strike of the Hosgri, indicating an almost east-west horizontal compression. The focal mechanisms you presented for earthquakes in these two areas seem to be in agreement with this assessment. How do you explain these apparent differences in stress orientation over a relatively small region and what implications does it have for the source characteristics of Hosgri earthquakes?

The magnitude 7.1 Loma Prieta earthquake of October 17, 1989 which occurred on the San Andreas fault exhibited characteristics which are relevant to the investigations that have taken place as part of the Diablo Canyon Long Term Seismic Program (LTSP). Typical earthquakes on the the San Andreas fault result from strike-slip motion on a vertical fault plane. On the basis of geologic and historic evidence earthquakes of about magnitude 5.5 or greater are also expected to exhibit tectonic surface fault rupture. Analysis of the Loma Prieta earthquake and its aftershock sequence indicates that the causative fault has a dip of about 70 degrees, the fault rupture began at a depth of about 18.5 kilometers and stopped at about 6 kilometers, never reaching the surface, and that the focal mechanism was oblique slip with about 1.4 meters of reverse displacement and 1.9 meters of strike slip displacement. In addition, the segments of the San Andreas fault just northwest and southeast of the Loma Prieta segment both exhibit evidence of pure strike-slip surface rupture. These characteristics exhibited by the Loma Prieta earthquake have raised some questions as to the assumptions, methods and interpretations used to characterize the Hosgri fault. As a means of resolving some of the concerns, we request that you respond to the following questions.

8. The logic tree parameters and weights used in the seismic source characterization result in the Hosgri being considered as primarily a strike-slip fault. As a means of assessing the impacts of differences of opinion, provide probabilistic seismic hazard calculations in which higher weights are put on reverse and oblique slips, such as 100 percent oblique slip; and 50 percent oblique slip, 40 percent strike slip, and 10 percent reverse slip. What is the effect on calculated seismically-induced core damage?

9. Provide empirical and numerical deterministic response spectra, (both horizontal and vertical components of motion), for an oblique earthquake mechanism and a reverse earthquake mechanism on the Hosgri fault. Include the input assumptions used and a comparison with the weighted magnitude 7.2 Hosgri earthquake presented in the LTSP Final Report.

10. The characterization of the LTSP Hosgri earthquake is based heavily on trench observations of near surface strike-slip on the San Simeon fault 50 kilometers north of the plant site. As noted above, surface observations at similar distances from the Loma Prieta fault break also show evidence for strike-slip motion although that earthquake had oblique slip. Justify giving heavier weight to distant data from the San Simeon than to geologic and geophysical evidence (e.g. dipping blind thrusts, coincidence of the Hosgri zone with the break in the sea floor slope, and the juxtaposition of older Franciscan rock on the east side of the zone with the thick Pliocene - Pleistocene section on the west side of the zone) in the Hosgri fault zone tens of kilometers closer to the plant site which support the hypothesis of large vertical motions on the zone.

11. Coastal uplift rates near Santa Cruz and near Diablo Canyon are similar, at about 0.2 millimeters per year. Under some postulations both coastal areas could be on the hanging-wall blocks of blind thrust or reverse faults. The fault near Santa Cruz is defined by aftershocks of the Loma Prieta earthquake and that near Diablo Canyon by interpretation of seismic reflection data. In both areas the reverse fault appears to be joined at depths on the order of a kilometer or so by a near vertical fault that exhibits Holocene surface displacement (i.e. the San Andreas surface break near Loma Prieta and the sea floor Hosgri off Diablo Canyon). List and discuss the criteria that were used to judge that the blind reverse members of the Hosgri zone are incapable of producing an oblique slip earthquake like that at Loma Prieta and greater than that assumed in the LTSP.

12. The maximum deterministic and probabilistic earthquakes on the Hosgri fault are anchored to geologic slip measured in the trenches at San Simeon. The Whittier, Coalinga, and Loma Prieta earthquakes demonstrate that large, damaging earthquakes may occur without leaving a record of discernible tectonically induced fault rupture in trench exposures. How does the LTSP compensate for this potential under counting of earthquakes and minimal estimate of geologic slip on the Hosgri, the Los Osos, and the San Luis Bay faults?

13. List and describe differences between findings in the 1988 LTSP Final Report and those arrived at as a result of subsequent investigations and analyses.