December 13, 1988

Docket Nos.: 50-275
and 50-323

DISTRIBUTION
Docket File
NRC & LPDRs
GHolahan
MVirgilio
JLee
OGC (for information only)
PDV Plant File
EJordan
BGrimes
ACRS (10)
HRood
GBagchi
RRothman
NChokshi

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 REGARDING THE DIABLO CANYON LONG TERM SEISMIC PROGRAM (LTSP) FINAL REPORT (TAC NOS. 55305 AND 68049)

In reviewing the LTSP final report, we have determined that the additional information identified in the enclosure is needed to continue our review. In order to maintain our review schedule, we request that you provide a response to the requested information on the following schedule:

1. Probabilistic Risk Analysis (PRA) questions - January 15, 1989.

2. Other questions - January 30, 1989.

If after reviewing these questions you find that you cannot meet the above dates for all questions, we request that you inform us of this in writing by January 1, 1989. Your letter should (1) identify the questions for which responses cannot be provided on the requested schedule, (2) provide the reason(s) that the proposed date cannot be met, and (3) specify an alternate date for response.

The reporting and/or recordkeeping requirements contained in this letter affect fewer than ten respondents; therefore, OMB clearance is not required under P. L. 96-511.

DF01
1/1

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

Sincerely,

Harry Rood

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

Enclosure:
Request for Additional Information

cc w/enclosure:
See next page

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

Sincerely,

original signed by Harry Rood

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

Enclosure:
Request for Additional Information

cc w/enclosure:
See next page

HR	P.K. for
DRSP/PD5	DRSP/D:PD5
HRood	GKnighton
12/13/88	12/13/88

OFFICIAL RECORD COPY

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

cc:
Richard F. Locke, Esq.
Pacific Gas & Electric Company
Post Office Box 7442
San Francisco, California 94120

Janice E. Kerr, Esq.
California Public Utilities Commission
350 McAllister Street
San Francisco, California 94102

Ms. Sandra A. Silver
660 Granite Creek Road
Santa Cruz, California 95065

Mr. W. C. Gangloff
Westinghouse Electric Corporation
P. O. Box 355
Pittsburgh, Pennsylvania 15230

Managing Editor
San Luis Obispo County Telegram
Tribune
1321 Johnson Avenue
P. O. Box 112
San Luis Obispo, California 93406

Mr. Leland M. Gustafson, Manager
Federal Relations
Pacific Gas and Electric Company
1726 M Street, N. W.
Washington, DC 20036-4502

Dian M. Grueneich
Marcia Preston
Law Office of Dian M. Grueneich
380 Hayes Street, Suite 4
San Francisco, California 94102

NRC Resident Inspector
Diablo Canyon Nuclear Power Plant
c/o U.S. Nuclear Regulatory Commission
P. O. Box 369
Avila Beach, California 93424

Mr. Dick Blakenburg
Editor & Co-Publisher
South County Publishing Company
P. O. Box 460
Arroyo Grande, California 93420

Bruce Norton, Esq.
c/o Richard F. Locke, Esq.
Pacific Gas and Electric Company
Post Office Box 7442
San Francisco, California 94120

Dr. R. B. Ferguson
Sierra Club - Santa Lucia Chapter
Rocky Canyon Star Route
Creston, California 93432

Chairman
San Luis Obispo County Board of
Supervisors
Room 270
County Government Center
San Luis Obispo, California 93408

Director
Energy Facilities Siting Division
Energy Resources Conservation and
Development Commission
1516 9th Street
Sacramento, California 95814

Ms. Jacquelyn Wheeler
3033 Barranca Court
San Luis Obispo, California 93401

cc:
Ms. Laurie McDermott, Coordinator
Consumers Organized for Defense
of Environmental Safety
731 Pacific Street, Suite 42
San Luis Obispo, California 93401

Mr. Jack McGurk, Acting Chief
Radiological Health Branch
State Department of Health
Services
714 P Street, Office Building #8
Sacramento, California 95814

Regional Administrator, Region V
U.S. Nuclear Regulatory Commission
1450 Maria Lane
Suite 210
Walnut Creek, California 94596

Ms. Nancy Culver
192 Luneta Street
San Luis Obispo, California 93401

President
California Public Utilities
Commission
California State Building
350 McAllister Street
San Francisco, California 94102

Michael M. Strumwasser, Esq.
Special Assistant Attorney General
State of California
Department of Justice
3580 Wilshire Boulevard, Room 800
Los Angeles, California 90010

ENCLOSURE

REQUEST FOR ADDITIONAL INFORMATION

DIABLO CANYON LONG-TERM SEISMIC PROGRAM (LTSP)
FINAL REPORT REVIEW

1. Provide the following deterministic comparisons of vertical ground motion estimates for Diablo Canyon and evaluate the significance of any differences:

   a. The Hosgri 0.75 g Newmark response spectra with the LTSP 84% free field response spectra.

   b. The LTSP 84% free field response spectra with the LTSP basemat motions resulting from the soil-structure interaction analysis of the 84% free field ground motions.

   c. The LTSP 84% free field response spectra with the 84% free field response spectra modified for justified spatial incoherency.

   d. The Hosgri "Tau" reduced Newmark response spectra for different structures with the corresponding LTSP 84% free field response spectra modified by the soil-structure interaction analysis and justified incoherency effects.

   e. Hosgri reanalysis floor response spectra and other structural response parameters with corresponding parameters developed by the LTSP using 84% free field ground motions, soil-structure interaction analysis, justified spatial incoherency, and consistent structural parameters.

2. Provide copies of the following reports referenced in the LTSP Final Report:

   a. Bechtel Power Corporation, 1988, "CLASSI" Computer Program: Theoretical Manual, User's Manual, and Validation Report.

   b. Bechtel Power Corporation, 1988, "SASSI" Computer Program: Theorectical Manual, User's Manual, and Validation Report.

   c. Kennedy, R. P., D. A. Wesley, and W. H. Tong, 1988, Probabilistic evaluation of the Diablo Canyon turbine building seismic capacity using nonlinear time history analyses: NTS Engineering Report 1643.01.

   d. Kipp, T. R., and others, 1988, Seismic fragilities of civil structures and equipment components at the Diablo Canyon Power Plant, NTS Engineering Report 1643.02.

3. Provide Summaries of interviews on geology, geophysics and tectonics held with J. Crouch, T. L. Davis, C. A. Hall, and B. P. Luyendyk.

4. Provide a discussion to explain the various ground motion estimates that

were made, what data was used in each estimate, details as to how the data were weighted and scaled, justification for the weighting and scaling, how the numerical modelling was used in the estimates, and which ground motion frequency and time domain estimates were used in the analyses. A figure with a matrix display might be helpful.

5. Provide the specific criteria used in the selection of the strong motion recordings used to develop the near source ground motion and the LTSP data base, including the definitions of rock and rocklike used.

6. Provide complete listings of all strong motion data bases used in the LTSP, including earthquake indentification information such as date, time, and location, and the magnitude, fault type, distance, site geology (surface material and depth of soil), instrument location (type of structure and size), and ground motion parameters. Explain specifically how each data base was used.

7. Provide an expansion of the information contained in Table 4-5 of the LTSP Final Report to include all 15 frequencies used in the analysis.

8. How were the constants in the attenuation relationship equations in Table 4-5 of the LTSP Final Report established?

9. Provide the calculations for determining the scaling and weighting factors, such as those in Tables 4-4 and 4-7 of the LTSP Final Report.

10. Observational evidence indicates that ground motion on the hanging wall of reverse faults is higher than on the footwall. If the Hosgri fault is a reverse fault Diablo Canyon would be on the hanging wall. How do your empirical estimates of ground motion take this into account?

11. What is the basis for assuming total magnitude saturation at 1 kilometer distance from the fault in Figures 4-18 and 4-19 of the LTSP Final Report? What would be the impact on ground motion estimates if this assumption were not made? What do numerical models show about magnitude saturation?

12. With respect to the numerical modeling method, the description provided in the LTSP Final Report is too general. A step by step description explicitly stating what was done at each stage (source, path and site) is needed.

13. Provide the following with respect to the numerical modeling:

    a. The Greens functions used in the modeling studies for different depths (0.2, 0.5, 1, 2, 3, 5, 7, and 10 km) and different distances (1, 3, 5, 7, 10, and 20 km) for frequencies of 0.1 to 15 Hz.

    b. The contours on the fault plane for the slip, the rupture time, the rise time (if variable) for all 48 of the simulations.

    c. The time histories for acceleration and velocity for the 14 events listed in Table 4-8 of the LTSP Final Report.

d. A complete description of the sensitivity studies, mentioned on page 4-23 of the LTSP Final Report, to evaluate the effects of shallow slip to ground motions.

e. A full description of the test calculations with respect to the adequacy of the generalized ray theory assumptions.

f. The comparisons with the Coalinga and Nahanni earthquakes as mentioned on page 4-10 of the Final Report.

g. A justification for the use of a constant stress drop of 50 bars. If the model is heterogeneous, what determines the heterogeneity distribution.

14. With respect to the site specific response spectra based on numerical modeling studies, page 4-39 of the LTSP Final Report, what models of shallow asperities were used and how did they compare to the no shallow slip model?

15. In the comparisons of the earthquake data to the simulations, why is the low frequency part of the spectrum always underestimated by the numerical simulations?

16. Provide a complete discussion as to how the 84th percentile numerical modeling estimates were made and how they address the various types of modeling, parametric, and random uncertainties. Determine quantitative goodness of fit measures for the numerical modeling procedures based upon the comparison of the numerical simulations with actual data from the Imperial Valley, Coalinga, Nahanni and Whittier Narrows earthquakes referenced in the LTSP Final Report.

17. What are the bases for (a) the lack of topographic and directivity effects at the Diablo Canyon site, (b) the site corrections used to adjust the Imperial Valley response spectra, and (c) the factors used to calculate the vertical to horizontal ground motion ratio.

18. Provide the response spectra for each individual numerical simulation referenced in the LTSP Final Report.

19. Provide the data related to the foundation rock properties and the results of the study performed to assess the sensitivity of the soil-structure interaction analysis to variation in the rock shear wave velocity profile.

20. On page 4-30 of the LTSP Final Report the statement is made that finite difference calculations show that topographic effects on ground motion at the Diablo Canyon site are insignificant. Provide the details of these studies.

21. As a result of the soil-structure interaction audit in June 1987 a detailed report on the computational program for both computational problems and problems using Diablo Canyon site specific calculations was to be provided in the Final Report. The Diablo Canyon site specific results were to be presented so as to clearly specify the limitations of the numerical results based on the computational limitations of the computer codes. This is needed to complete the review.

22. Provide the detailed results of the soil-structure interaction parametric studies to support the conclusions reported on pages 5-14 and 5-19 of the LTSP Final Report.

23. Identify the time histories used in the soil-structure interaction analysis and provide a discussion as to how they were modified.

24. Provide support for the statement that the two results of the soil-structure interaction study presented in the report are consistent with the response that can be obtained using the ensemble of all the site specfic earthquake data.

25. The uplift calculations performed for Containment Building indicate that by halving the lateral side springs, little difference was noted in calculated response. This does not seem to agree with the statement made that depth-of-burial effects are important. Also, the loss of sidewall stiffness due to soil compaction is not clearly related to a simple reduction in lateral stiffness. Justification for these assumptions should be provided.

26. For the higher spectral acceleration levels required for the probabilistic hazard assessment program, lift-off effects may be much more serious than indicated in the report and should be discussed. The effects of slap-down following uplift were shown to cause a frequency shift in the primary soil-structure interaction response. This effect was apparently not included in the site specific soil-structure interaction calculations for uplift. A discussion should be provided.

27. The effects of small perturbations in the time phasing between horizontal and vertical input motions on potential lift-off effects and equipment support point spectra should be provided.

28. The three suites of input seismic motions used for the lift-off calculations were different from the site specific inputs defined and used for the remainder of the soil-structure interaction study. The specific differences should be evaluated and provided.

29. In the section of Chapter 6 concerning shear wall drift limit, the values D = 0.7% and Beta c = 0.335 are presented. The source of these values should be detailed and their derivation clearly described. Data from studies of this subject seem to indicate that both of these values are not in the conservative range for a shear span ratio of about 0.4 (i.e. the walls 19 and 31 of the Turbine Building). If these values change, the fragility values may change drastically.

30. There is a large eccentricity in the floor mass distribution along the north-south axis of the turbine building. The center of mass of the operation floor is about 38 feet off the center of rigidity defined by two shear walls. This may cause an additional shear distress in the shear walls due to torsional vibration. Since this effect cannot be accounted for in the 2-D model presented in the text, how was it evaluated?

31. Provide the detailed basis for the development of the fragility of the offsite power for both the 500-kv and 230-kv systems.

32. Provide the fragility calculations for the following components:

    a. The 4-kv switchgear.

    b. The CCW heat exchanger.

    c. Revised calculations of the RHR heat exchanger and spray additive tank.

    d. The diesel generator control panel.

33. Provide a discussion of how the following observations made during the plant walkdown of March 1988 were addressed:

    a. Safety related conduits were noted to traverse (vertically) the seismic joint between the auxiliary and turbine buildings.

    b. The 4-kv potential transformers and switchgears were noted to be close to each other allowing for potential interactions between them.

    c. For the turbine driven auxiliary feed water pump some of the feed water line valves' operators were observed to be either resting on or very close to supports allowing for possible interactions.

34. In addition to the information requested at the September 12-15, 1988 Probabilistic Risk Assessment meeting, provide the following information:

    a. Section 4, Seismic Analysis, of Volume 2 of the PRA report.

    b. Appendix A, Analysis for Determining Success Criteria, of Volume 2 of the PRA report.

35. In order to perform the review of the human action analysis (HAA), as part of supplementing Appendix G to the PRA, data and information addressing the following should be provided:

    a. What personal characteristics (e.g., experience), performance aids (e.g., training, procedures) and other performance shaping factors were scaled for each human task in the accident sequences of interest? How were these factors chosen? And, what methods (including rationale for their choice) were used to scale each performance shaping factor?

    b. What specific decision making and execution actions were analyzed for each task in each accident sequence?

c. What analysis methods (e.g., THERP, SLIM-MAUD) were used (including rationale for their choice) to achieve error probability point estimates for each task with a sequence?

d. What were the sources of base human error probability estimates that were used as inputs to each analysis? Were Diablo Canyon training simulator data used to supplement these base estimates? If so, how?

e. What characterization or behavioral model of plant personnel was used to identify multiples and dividends of the base error probabilities that were used in the sensitivity analysis?

f. What inferences (insights) are drawn (in line with information responding to a. thru e. above) regarding the contribution of human performance to overall plant risk?

36. Provide a discussion of criteria used for the truncating of cutsets and identify the leading cutsets. Also, identify the cutoff frequency for binning unused support states.

37. Provide the information about seismic sequences on a diskette as discussed during the October 20, 1988 conference call.

38. Provide the entire Appendices D and E of the PRA report.

39. The shear deformation hysteretic behavior shown in Figure 6-30 of the LTSP Final Report assumes bilinear behavior. After cracking, reinforced concrete exhibits significant softening behavior. Indicate how this was included in the analysis.

40. With respect to the logic tree analyses, such as Figures 3-5, 3-6, and 3-8 of the LTSP Final Report, many of the weights assigned to the branches appear to be unrelated to evidence obtained from the geology-seismology-geophysics investigations; the rationale and justification for the process by which the weighting factors were assigned should be detailed.

41. With respect to the northern termination of the Hosgri fault zone and its relationship to the San Simeon fault zone, provide seismic reflection and other geophysical information that support the existence and nature of the Cambria stepover, the northern termination of the Hosgri at the Point Piedras Blancas structural high, and that show that the San Simeon does not extend southward into Estero Bay.

42. The Sisquoc reflector and the Pleistocene designated in the seismic profiles (Plate 7 of the LTSP Final Report) appear to be inconsistent with the ages for these units as described by R. Heck at the November 14-18, 1988 audit. Please clarify.

43. Provide the following:

a. Additional evidence supporting the interpretation that the Pecho fault is an important part of the fault system comprising the southwest boundary of the San Luis-Pismo structual block.

b. Additional evidence supporting the interpretation that the Pecho fault is a point of segmentation of the Hosgri fault zone.

c. Data showing the relationship between the Hosgri fault zone and the northwest termination of the Los Osos fault.

d. Data showing the southern termination of the Crowbar Canyon fault.

e. Data that support the conclusion that there are no unidentified young faults in the near offshore of the Diablo Canyon site that could impact the site ground motion estimates.

f. Seismic reflection and other geophysical information that support the validity of the six points of segmentation of the Hosgri fault zone.

g. Seismic reflection and other geophysical information that support a southern termination of the Hosgri fault zone near Point Perdinales.

h. Seismic reflection and other geophysical information that show reversals in apparent sense of vertical slip along the Hosgri fault zone.

i. The laboratory and paleontologic reports with supporting data for all the absolute and relative dates (carbon-14, amino acid, uranium-thorium, thermoluminescence, faunal assemblege, etc.) for Quaternary stratigraphy, geopmorphic features, or structural deformation. Provide the preliminary profiles, report, and supporting data for various models of shoreline deformation and block uplift rates; there were good drafts shown at the November 14-18, 1988 audit that explored application, and non-application of different models. The shoreline angle data should include borehole iterpretations and logs. Any additional data that demonstrates a southward tilt of the Irish Hills and Edna subblocks of the Pismo block should be provided.

j. The natural exposure and exploratory trench logs for fault traces and adjoining areas that were not included in the final report. The draft profiles from the San Simeon, Los Osos, Edna, San Miguelito, and Wilmar Avenue fault zones, examined at the November 14-18, 1988 audit, form the nucleus of this request.

k. The geologic cross sections across the Hosgri, Los Osos, San Luis Bay faults, Pismo Block, and Santa Maria basin, showing subsurface control from drill holes, and the overlay with recent earthquake hypocenter and focal mechanism data for the Pismo block-Estero Bay area. Include any preliminary balanced cross sections.

l. The Tina Niemi, Tim Hall, and Jerry Schiller analysis, including the Phoenix Arizona GSA Meeting poster session data for bathymetric and high resolution seismic information on the Hosgri fault zone.

m. The gravity and magnetic contour maps for the offshore region along the Hosgri fault zone.

n. The high resolution and CDP reflection profiles which show the style of deformation, continuity, and possible surface and subsurface position of segmentation points for the following:

(a) The Cambria step-over between the San Simeon and Hosgri faults.

(b) Estero Bay - Los Osos zone of deformation east of the Hosgri fault.

(c) Hosgri fault west of Pt. Buchon and Diablo Canyon.

(d) Offshore SW border of the Pismo block including seismic lines across the San Luis Bay-Rattlesnake trace, Olson trace, and offshore escarpments.

(e) Zone of intersection between the Hosgri and Pecho faults, including mid-points and gaps along the Pecho fault.

(f) Intersection of the Casmalia fault and Hosgri faults.

o. 1:24,000 scale work maps (D series) showing ship-track lines for high- and intermediate-resolution seismic data, registered to geologically interpreted, offshore, faults and folds.

p. 1:24,000 scale bathymetric maps D5 and D6 showing sea floor topography and 2 meter countour interval.

q. All trench logs of the San Simeon fault and the Los Osos fault with all back-up notes on original field observations and interpretations of the logs.

r. Records of borings to establish the position of marine wave-cut platforms and shoreline angles between Estero Bay and Pismo Creek, with profiles, logs, elevation control, and subsurface interpretaion.

s. All available drill logs, core descriptions, age control, and dipmeter surveys from the Honolulu Tidewater USL Heller well, Pismo syncline northeast of Diablo Canyon Plant.

t. Documentation of high-resolution seismic profiles crossing the Hosgri fault between Point Estero and Point Sal, and high-resolution seismic profiles crossing the Los Osos fault offshore, with the accompanying notes and raw and interpreted records.

u. Deep crustal reflection lines acquired by Digicon in 1986 (e.g., plate 8 of the LTSP Final Report). Of interest are all three lines processed for shallow Tertiary basin interpretation and deeper crustal models for tectonic analysis. All lines whether processed for shallow or deep interpretation should contain full record section.

v. In addition to the seismic lines requested in other questions GSI 84, 85, 86, 95, 96, 103; CM-86-45, CM-86-49; NEKTON 202; and COMAP high resolution line nearest to NEKTON 202 and GSI 103.

w. Vibroseis lines, Santa Maria Valley and vicinity as shown in plate 9 of the LTSP Final Report.

x. Focal mechanisms and earthquake relocations for post-1927 earthquakes within 50 kilometers of the Diablo Canyon Plant, as determined by PG&E.

y. Draft isopach, structural contour, and distribution maps for the offshore late Tertiary post-Monterey units.

z. Draft reports and seismic reflection data (including high resolution profiles) for the style, rates and timing of deformation on the section across the Queenie structure to the Pt. Sal area, and also for the Lompoc structure.

aa. Tabulation by Peter Kneupfer of world wide data of rupture behavior of faults at fault segments and the charts that he showed at Palm Springs and the Denver GSA meeting.

44. Explain the process by which the maximum magnitude earthquake of 7.2 Mw on the Hosgri was derived from the probability distribution with a mean value of 6.96 Mw in Figure 3.9 of the LTSP Final Report. Was this process also employed for the Los Osos and San Luis Bay faults?

45. Given the very large number of outcomes for the probability distributions for magnitude (Figures 3-9 through 3-12 of the LTSP Final Report) and the very different shapes they exhibit, has any sensitivity analysis been done to detect what contributes to the largest excursions in these distributions?

46. Confirming the method that was used to relocate the 1927 Lompoc earthquake by using it for other events in the region that have been located independently would provide confidence as to the accuracy of the relocation. Using the same technique as discussed in the text and shown in Figure 2-27, locate other earthquake.

47. Are there stations other than Debilt that recorded the 1927 Lompoc earthquake that could be used for location and magnitude determinations? If so, provide that information.