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May 11, 1989

Bob Rothman, MS 8D30
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Dear Bob Rothman:

This letter provides my comments on PG&E's current status of work as shown by the Long Term Seismic Program Final Report, and to responses for the NRC questions. In particular, I examined Questions 3, 40, 41, 42, 43, 44, 45, 46 and 47 using the additional information provided by PG&E. My comments are discussed in two parts -- the Responses to Individual Questions and the Discussion of Unresolved Issues.

As part of my overall review for NRC, I feel that I should bring up alternative interpretations that may differ from PG&E's position. The purpose of my bringing up these concerns is to insure that a fuller spectrum of issues is discussed at the June meetings. I am near agreement with PG&E on most of the issues discussed in the Final Report. In general, I feel that their investigations are very comprehensive and well conducted. The following comments are not intended to be critical of the overall studies, but to bring up questions that will lead to a more complete closure of remaining issues.

I will continue to review the additional information, particularly on style of deformation and proposed segmentation points for the Hosgri fault, behavior and continuity of faults bounding the San Luis Range, and Chapter 3, SEISMIC SOURCE CHARACTERIZATION. My comments and concerns are outlined here for the June 12-16 meetings.

Responses to Individual Questions:

Many of the PG&E responses, I believe, adequately summarize and clarify the present data base or state of knowledge. Specific comments for each question follow:

Question 3: Provides summaries of interviews on geology, geophysics and tectonics held with J. Crouch, T.L. Davis, C.A. Hall, and B.P. Luyendyk.

The response presents a thorough and reasonable summary of interviews with the four individuals. Although it is a synthesis of more detailed comments that were made at the oral interviews, it presents most of the key points discussed.

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Question 40: Weighting used for logic tree analyses.

The discussions did not resolve, for me, a number of issues related to the weightings that should be used for this type of analysis. The rationale and justification for assigning weights to various branches of the logic trees appears to be subjectively determined. I recommend that background information specific to this question be discussed in greater detail at a future NRC/PG&E meeting.

The data presented by Pete Kneupfer in a report to be published soon in the U. S. Geological Survey Open-File Report entitled "Segmentation and Controls of Rupture Initiation and Termination", and a study by Craig dePolo, Doug Clark, and myself, on historical surface faulting in extensional regions in western United States, indicate that there may be some difficulties in applying segmentation models. Although the strike-slip, oblique-slip and normal-slip faults in the Basin and Range province may not be directly equivalent to the contractional or transpressional setting in coastal California, some of the historical examples suggest that multiple segments can rupture during an earthquake event. For example, the 1872 Owens Valley earthquake (strike-slip) probably ruptured in four segments, the 1954 Fairview Peak earthquake (oblique-slip) ruptured in three complex fault segments, and the 1915 Pleasant Valley earthquake (normal-slip) ruptured in four or five separate, en echelon fault segments. In view of these historical examples, PG&E should provide more detailed justification for logic tree weightings of multiple segment ruptures.

Question 41: Provide discussion and seismic reflection profiles for the Cambria stepover.

The seismic reflection data provided by PG&E forms, in general, an adequate basis for the response. The existence of apparently normal faults within the Cambria stepover clearly indicates extension in this area. It appears to me that the five km wide Cambria stepover probably is the best constrained segmentation point for the Hosgri fault. I would like to see further discussion of empirical relations between stepover width and surface fault ruptures. For example, at Poverty Hills in the Owens Valley strike-slip fault of 1872, surface faulting ruptured through a 5 km wide stepover at Aberdeen, and for an additional 25 km beyond the stepover.

Question 43: Response to 27 questions with proprietary data.

Question 43a, 43b: The tectonic role of the Pecho fault.

There are still some concerns that there is not sufficient data provided to resolve the issue as to whether ~~the~~ Pecho fault is the dominant or controlling structural element at the southwestern edge of the San Luis/Pismo block. The importance of this structure and its relation as a segmentation point for the Hosgri fault needs further discussion. The issue of the character of the southwestern boundary of the block is discussed later.

Question 43d: Supply data for the Crowbar Canyon fault.

Although the Crowbar faults extend shoreward of PG&E's geophysical coverage, the absence of marine terrace displacements onshore, and the lack of geomorphic expression within the range, probably indicate lack of capability. There is an apparent discrepancy in the age of faulting shown by PG&E in the Final Report and that shown in Tina Niemi and others GSA poster session in Phoenix (which indicates deformation of post Wisconsinian sediments on parts of the Crowbar fault zone). This discrepancy should be resolved.

Question 43e: Provide data to support the conclusion that there are no unidentified young faults in the near offshore of the Diablo Canyon site.

The data provided by PG&E appears to be as complete as geological and geophysical methods permit, and their discussions are thorough. We concur that PG&E's detailed marine terrace investigation probably preclude existence of significant faults in the onshore region. Is it possible that the distributed deformation on the southwestern edge of the San Luis/Pismo block is part of a narrower, more continuous and integrated seismogenic structure? This interpretation is suggested by the shallow shelf between the Pecho fault and the coastline, by the steep linear coastline between Pt. Buchon and Pt. San Luis, and by the 0.2 mm/yr uplift rate of the Irish Hills subblock that shows little or no tilt. This inferred fault would be a reverse fault, possibly a mirror image of the Los Osos fault, and could extend a significant distance to the southeast.

The location of this inferred structure in relatively shallow water would make it extremely difficult to image by offshore seismic reflection techniques. Plate 19 of the Final Report shows a northwest-trending lineament in the near offshore near the site that PG&E classifies as a shoreline related lineament. Alternatively, could this lineament comprise fault scarps of the inferred coast-parallel fault? The lineament as mapped cuts across topographic contour lines, suggesting a possible fault origin. More data is needed to resolve how accurately this lineament was mapped, and whether it has tectonic implications.

Question 43g: Southern termination of Hosgri fault zone.

This issue is not completely resolved. However, the geodetic data of Kurt Fiegl of MIT shows the onshore region near Pt. Pedernales moving with the Pacific plate west of the Hosgri fault. This supports PG&E's proposed termination of the Hosgri fault near Pt. Pedernales.

Question 43h: Reversals of apparent sense of vertical slip on the Hosgri fault.

Although there are some demonstrated reversals in the apparent sense of vertical slip along the Hosgri fault, including both northeast facing sea floor scarps and apparent reversals of stratigraphic offsets, the vast majority of seismic lines show southwest facing scarps and northeast-side-up apparent displacements. Does this suggest a significant reverse component of displacement on the Hosgri fault?

Question 43i: This question include extensive data requests on dating for the marine terrace studies, exploratory trenches, and boreholes.

This response is comprehensive and very well presented. PG&E did a thorough job of mapping marine terraces during the LTSP. All relative and absolute dating methods were employed and experts were consulted on various aspects of the terrace study. The San Simeon area, in particular, is a difficult area to study due to complex faulting, burial of marine terrace remnants by eolian sand and alluvium, and poor age control. PG&E's relative dating of terraces and terrace correlations across fault traces are reasonable, and alternative scenarios were seriously considered by PG&E.

The longitudinal profiles of marine terrace shoreline angles (Plate 12 of the Final Report) convincingly show uniform block uplift of the Irish Hills subblock of the San Luis/Pismo block over the past approximately 125,000 years. Marine terrace Q3 and older terraces suggest that there is a slight southwestward tilt of the block. On the southeastern boundary of the Irish Hills subblock, Katie Killeen's terrace analysis showed evidence for no tilting, or only slight northeastward tilt of the block. In addition, there is no evidence of synclinal or anticlinal folding of the block over the past approximately 500,000 years.

Question 43j: Request for natural exposure and exploratory trench logs.

The logs and supporting report are thorough, of high quality, and are up-to-date. This information assists our review of many of PG&E's positions on geologic issues, and demonstrates the comprehensive onshore investigations conducted by PG&E both on the margins of the San Luis Range and within the block. The main conclusion that can be made from these data are that the San Simeon, Los Osos, San Luis Bay, and Wilmar Avenue faults are

capable faults. Also these data clearly show that the Edna and San Miguelito faults are not capable faults.

<u>Question 43k:</u> Request for geologic cross sections with a seismicity overlay.

This response is adequate. We concur that accurate balanced cross sections probably cannot be made in this area due to the complexity of the underlying Franciscan Complex. The interpreted high angle dips of the Los Osos fault and the Wilmar Avenue fault are not well constrained by well data or by seismicity. The focal mechanism data may suggest moderate dips on structures at seismogenic depths.

<u>Question 43l:</u> This question was a request for data from a poster session.

The reason for this request was to review sea floor geomorphic evidence for strike-slip displacement on the Hosgri fault, a conclusion that is strongly stated in the poster's abstract. The data to support this conclusion was not submitted by PG&E. On the contrary, the figures from the poster session provided by PG&E show almost exclusively southwest facing seafloor scarps, which does not clearly support a strike-slip origin. If there is additional geomorphic data that supports a strike-slip interpretation for the Hosgri fault, it should be provided.

<u>Questions 43m to 43z:</u> Various data requests for offshore data, primarily seismic reflection data.

These data are currently being reviewed and studied, primarily to verify possible segmentation points along the Hosgri fault.

<u>Question 43aa:</u> Empirical segmentation studies.

Pete Knuepfer's research on segment boundary characteristics suggests that the best segmentation points or diagnostic fault discontinuities occur at the ends of historical earthquake surface ruptures about 25 to 35 % of the time and are ruptured through in the remaining cases. In a similar study, for extensional historical faulting in western United States, dePolo, Clark and Slemmons find that about 50 percent of the ruptures terminated in some type of identifiable segmentation points. PG&E states that coincidence of several diagnostic characteristics is probably significant in determining segmentation points. This appears to be a reasonable relation. However, I have not seen or compiled data on this issue. This relation should be supported by quantitative data.

Question 44: Procedure for determination of the maximum earthquake magnitude.

PG&E uses a state of the art approach to estimating maximum earthquake size, with a combination of deterministic and probabilistic analyses. Since this is a state of the art analysis, I would like to have a detailed walk through explanation of the methodology and techniques used by PG&E. This should be presented at a future NRC/PG&E meeting.

Some of the issues that I would like to see addressed include:

How is the frequency of earthquake recurrence used?

What are the uncertainties and effects of alternatively assigned weightings?

Should analyses be made for end-member alternatives of oblique-slip, reverse-slip, and strike-slip possibilities, rather than inclusion of highly unlikely values?

How was it determined that the Los Osos and San Luis Bay faults contribute only a very small percentage to the probabilistic earthquake, and what effect, if any, would there be for larger magnitude events on the southwestern border zone of the San Luis/Pismo block?

Question 45: Logic tree - sensitivity analysis.

This response demonstrates the significant effect that alternatively assigned probabilities can have on maximum earthquake size. This is particularly true for rupture length (Figure Q45-5). I request that a more comprehensive sensitivity analysis, using alternatively assigned probabilities for the more uncertain and less well constrained fault parameters, be presented at a future meeting.

UNRESOLVED ISSUES

Some of the more important issues that have not been resolved include the following:

<u>Issues related to the Hosgri fault system:</u>

1. <u>Segmentation Points:</u> The number of segmentation points and the length of possible rupture segments on the Hosgri fault needs further discussion. Our efforts, as well as review materials provided by PG&E for the June meeting, need to emphasize this topic. What is the proper weighting that should be placed on fault segmentation, particularly for strike-slip faults in compressional settings?

2. <u>Possible Strain Partitioning:</u> Although PG&E presents a strong case for predominantly strike-slip Quaternary fault deformation on the Hosgri fault, there appears to be evidence in some of the seismic reflection profiles for Quaternary reverse faulting and folding on elements of the Hosgri fault system. Is there a possibility of partitioning of deeper oblique-slip faulting to give some combination of active reverse-slip faulting and folding on the moderately-dipping western traces of the Hosgri fault system, and strike-slip faulting on the parallel, high angle faults? There are several examples of this relationship along historical surface faults and paleoseismic fault zones in other regions. Strain partitioning in the uppermost several km could account for the complex fault geometry, and could explain some of the differences in tectonic models proposed by various workers.

3. <u>San Simeon and Hosgri fault zone slip rates:</u> Despite the detailed and diverse types of geologic investigations by PG&E on the San Simeon fault zone, the horizontal slip rate for the Hosgri fault system is not well constrained. Because the estimated late Quaternary slip rate for the San Simeon fault zone is extrapolated to the offshore Hosgri fault, it is critical that all of the horizontal deformation at the San Simeon latitude be captured. Is this deformation constrained to a 120 m wide zone at San Simeon Cove? Is it possible that part of the deformation is transferred eastward along the seismically active Oceanic and Nacimiento faults? Is there Quaternary deformation to the west, along several northwest-trending faults offshore of Point Piedras Blancas (Plate 4, Sheet 3 of the Final Report)?

<u>Issues Related to Southwestern Boundary of the San Luis - Pismo Block:</u>

The issues include such questions as the following: What is the location, character, and slip rate of the southwestern boundary zone of the San Luis - Pismo block? How and where is the tectonic deformation for this zone distributed, including relations of the Oceano fault, Pecho fault, Wilmar Avenue fault, and the inferred offshore fault between Pt. Buchon and Point San Luis (See response

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PG&E emphasizes the distributed and non-continuous nature of the boundary fault system on the southwest margin of the San Luis Range. PG&E has demonstrated the uniform block uplift and lack of major tilting of the San Luis - Pismo block in late Quaternary time. This suggests that the northeastern and southwestern boundaries of the San Luis/Pismo block have similar rates of activity. Is it possible that at seismogenic depth there is a fault zone bounding the southwest margin of the San Luis - Pismo block that has greater continuity than shown by surface expression? If so, does this fault zone have a potential that is comparable to that of the Los Osos fault?

Issues Related to the 1927 Lompoc Earthquake: The epicenter of this event is assigned to the South Coast Compressional Domain "west of the southern extension of the Lompoc structure as it trends past Point Arguello and to the east of the southern end of the Santa Lucia Bank fault". What is the earthquake potential for the major Quaternary structures of this zone? What is the evidence for "low-level late-Quaternary deformation" in this region?

Earthquake Magnitude Scaling: Although it is not part of the PG&E report, I wish in this memo to call attention to work in progress by Don Wells, Kevin Coppersmith, Xiaoyi Zhang, and myself. This study, although in an early stage, appears to show that in the magnitude range of 6.5 to 8.0, the Ms magnitudes are about 0.1 to 0.2 higher than the Mw or moment magnitude. This suggests the possibility that the estimates of maximum earthquake magnitude (mostly Ms) may not be exactly equivalent to design earthquake magnitudes (Mw). Does this affect the strong ground motion analyses?

Sincerely,

David B. Slemmons

David B. Slemmons

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United States Department of the Interior

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April 18, 1989

MEMORANDUM

To: Bob Rothman

From: Bob Brown Bob Brown

Subject: Discussion topics for June 12-16 meeting regarding Diablo Canyon Long-Term Seismic Program Final Report

Enclosed are eight questions intended to resolve or clarify geologic problems regarding Diablo Canyon. They are in question format because, after discussion with Lloyd Cluff and Woody Savage on 10 April, we agreed that this would provide the most amicable framework for discussing differences.

Many more questions could be raised; I have intentionally withheld those regarding the logic tree, the maximum magnitude deterministic earthquake, and maximum magnitude probabilistic earthquake--that derived from the logic tree. Clearly, however, the preferred interpretation indicated by these questions is that the Hosgri is a broad, northeast-dipping, complex fault system dominated by oblique, right-reverse, or thrust slip. This interpretation has a significant effect on the structure and weighting of the logic tree and on its mean-value earthquake magnitude. It will have less effect on the size of the maximum magnitude deterministic earthquake. It may increase that magnitude by 0.2 or 0.3 magnitude units, but probably its most important effect will be to add a vertical-slip component to the ground motion.

In any event, it is important to discuss the evidence bearing on these questions before moving on to those regarding the logic tree and other Chapter 3 (Seismic Source Characterization) issues. If we can resolve these differences in geologic interpretation, then we will have agreed that parts of Chapter 3 need to be modified and will already be well down the road to completing that task. I hope that we can accomplish this and can do so expeditiously. I am optimistic about this because I think the evidence is compelling, multidimensional, and several lines of it are independent of others. This is largely because PG&E has aggressively sought the earth-science evidence that is important to the Diablo Canyon earthquake issue. What has emerged has proved to be different, in several ways, from what many of us expected, but it provides a much better basis for evaluating ground motion and seismic risk.

Enclosure
cc: L. Cluff
D. B. Slemmons
RDB:cr

R. Brown/USGS/04/16/89

**DISCUSSION QUESTIONS FOR REVIEW OF FINAL REPORT:
PG&E LONG-TERM SEISMIC PROGRAM**

SAN FRANCISCO, CALIFORNIA
12 to 16 JUNE, 1989

QUESTION 1: Viewed transverse to its N30W trend, what structural elements define the active Hosgri fault system for the purpose of the Long Term Seismic Plan?

This question is prompted by an emphasis, in the final report (PG&E, 1988), on evidence derived from surface faulting along the mapped traces of the San Simeon and Hosgri faults. This evidence is important, but other evidence of recent deformation west of these mapped fault breaks is also relevant to issues of concern in the hazard assessment.

Throughout the report, the more steeply dipping eastern members of this fault system are recognized as active and capable of producing damaging earthquakes; they cut off or offset the wave-cut platform, marine deposits that are younger than 18,000 years before present (18 ka), and late Quaternary (100 ka or less) shoreline features that are now tens of meters below sea level. But this is not the only evidence of geologically recent activity. At depths of 2 km or more, a southwestward-verging set of reverse and thrust faults branches from the more westerly of these obviously active fault traces. These northeast-dipping reverse and thrust faults deform an unconformity dated at 1.7 to 3.0 million years before the present (1.7-3.0 my), locally warping that surface to dips of 20° to 40° (PG&E, 1988, plate 6, depth-corrected sections); south of the latitude of Point Sal, deformation along these faults extends to the seafloor, and exceeds the deformation on the steeper member of the Hosgri to the east (PG&E, 1988, plate 7, sheet 3). As the structural maps (PG&E, 1988, plates 4 and 5) and interpreted seismic records show, these reverse and thrust faults are part of the Hosgri system of faults. That many of them are active at depth is shown by the deformed 1.7 to 3.0 my unconformity, seafloor relief, and--south of Point Sal--the distribution pattern of late Quaternary sediment. This set of blind thrust faults provides important clues to the structure of the Hosgri fault system at earthquake depths and to its probable failure geometry during large earthquakes.

QUESTION 2: What criteria are applied to define the longitudinal extent of the Hosgri fault system as an active, earthquake-producing, structure?

This question is closely related to question 1. Key structural elements, recognizable in transverse sections of the Hosgri fault system, can help define the continuity of the fault and can identify major changes in structure or trend. Lithology-independent criteria are especially important north of Point Estero, where acoustic basement west of the fault system lies at relatively shallow depth beneath the seafloor.

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QUESTION 3: Please explain more fully the reasons for interpreting the Hosgri fault as a steeply dipping (80°-90°) structure.

The reasons given on p. 3-19 of the final report imply that a lack of data at earthquake depths has compelled the authors of the report to deduce the fault dip from a preferred theoretical tectonic model. This model requires nearly pure right-lateral strike slip and is justified by arguments summarized in tables 2-10 and 2-11 (PG&E, 1988, p. 2-109 through 2-111). The arguments on p. 3-19 of the final report, and some of those in tables 2-10 and 2-11, conflict with observational data that support a much lower dip and a somewhat different fault mechanism for the Hosgri fault system. Briefly, the evidence for the lower dip is:

- Depth-corrected seismic-reflection lines (PG&E, 1988, plate 6), as interpreted by PG&E investigators, exhibit average dips of about 78° near the surface and 64° near the bottom of the interpreted part of the record at 3 to 4 km depth.

- Because as noted above dips diminish with depth, they are probably lower than the observed values at the 4 to 12 km depths where most earthquakes occur.

- Many seismic-reflection records, including several that have been depth corrected, show a flattening of the fault dip below the point where a low-angle thrust or reverse fault joins a steeper, more easterly, fault branch. The convergence at depth of several of these low-angle faults with the Hosgri (see, for example, PG&E, 1988, plate 7, sheet 2) suggests a further decrease in fault dip with increasing depth.

- Focal mechanisms for earthquakes larger than magnitude 3 along the Hosgri and San Simeon faults are chiefly thrust, reverse, or oblique slip with dips of 75° or less. Larger earthquakes along the Hosgri-San Simeon trend, and those further offshore, tend to show the lowest dips on focal planes (PG&E, 1988, fig. 2-32 and table 2-9).

- Although seismic activity is neither abundant nor sharply defined along the Hosgri and San Simeon faults, cross sections normal to these faults show weakly defined 55° to 60° northeast-dipping trends for earthquake hypocenters that extend from the surface to about 12 km (PG&E, 1988, fig. 22-33 and fig. 2-35, A-A').

QUESTION 4: Several lines of geologic and geophysical evidence indicate a late Quaternary component of vertical slip on the order of 1 to 2 mm/yr. How do you reconcile this evidence with the dominantly strike-slip interpretation adopted in the report?

Some of the evidence for a vertical slip component is:

- More than 200 km of seafloor faulting is shown on map sheets of plate 4 (PG&E, 1988,); 75 percent of the faulting displacement shown is down to the west as documented by west-facing scarps. East-facing scarps are dominant only south of the latitude of Point Sal, where the most active recent deformation lies along the Purisima structural trend to the west of the mapped trace of the Hosgri.

- Between Point Estero and Point Sal, the mapped seafloor break of the Hosgri fault coincides with a break in the topographic slope of the seafloor: a shallow, nearshore, nearly horizontal and chiefly erosional platform lies northeast of the fault; a deeper, seaward-sloping and chiefly depositional surface lies to the southwest. The alinement of the shelf break with the fault persists despite differences in lithology, age, and resistance to erosion of the rocks on the northeast side of the fault--an indication that vertical uplift of the northeastern block is sufficiently rapid to maintain the position of the shelf break.

- Many of the seismic reflection lines crossing the Hosgri fault system (PG&E, 1988, proprietary data and plate 6) show deformation of a reflecting surface interpreted as the 1.7 to 3.0 my unconformity--the "mid-Pleistocene unconformity" of several plates and figures in the report. Typically, uplift of this marker increases northeastward toward the mapped surface trace of the Hosgri, and the marker is absent or only locally preserved northeast of the fault. The amount of structural relief (0.5 to 1 km) and the dip (20° to 40°) of this initially horizontal surface imply sustained vertical deformation that is probably still continuing.

- Focal mechanisms of earthquakes larger than magnitude 3 (PG&E, 1988, fig. 32) along the Hosgri-San Simeon trend and in adjoining regions to the northeast and southwest are predominantly thrust, reverse, or oblique slip; those along the Hosgri-San Simeon trend are consistent with an uplifted eastern block--as is also indicated by the geologic and geophysical evidence.

- A linear belt of submarine slumps and submarine-canyon headwalls lies southwest of and within a kilometer or two of the Hosgri trend in several areas (PG&E, 1988, plate 4, sheets 1 through 3); these suggest a linear belt of seafloor instability that correlates areally with underlying deformed sedimentary deposits of late Pliocene to late Quaternary age. The relations can be interpreted as evidence that uplift along the Hosgri is sufficient to elevate the seafloor to a gradient steeper than the normal angle of repose for newly deposited marine sediment.

QUESTION 5: Please discuss evidence, other than that derived from instrumental seismology, that bears on the location and magnitude of the 4 November, 1927, earthquake in the offshore Santa Maria basin.

The final report substantially revises the location and magnitude of the mainshock from locations and magnitudes that are similarly based on instrumental seismology records and that have been reported in published journal articles by other investigators (Byerly, 1930; Jeffreys and Bullen, 1935; Gawthrop, 1978; Hanks, 1979). Other evidence that helps ~~ev~~aluate mainshock location and magnitude are:

- The distribution of felt intensities as mapped by Byerly (1930, fig. 1) and Toppozada and Parke (1982, p. 47).

- Intensity modeling of different fault lengths and locations (Evernden, 1981, p. 27-36), which tests the fit of different fault models to the observed intensity patterns.

- Observations of the relative severity of the mainshock by the masters of vessels at sea off Purisima Point ("Alaska Standard," less than 20 km offshore) and Point Sal ("S.S Socony," 31 km offshore), as reported by Byerly (1930, p. 60).

- The magnitude (7.6) of the tsunami generated by the earthquake and determined by the maximum amplitude of the tsunami wave in meters; tsunami magnitude is approximately equivalent to moment magnitude (Abe, 1979).

QUESTION 6: The Los Osos, Pecho, and Casmalia faults are considered in the final report as defining the boundaries of independent, seismically active, segments of the Hosgri fault system, yet they are truncated by the Hosgri and, as they approach it, are deformed in a right-slip sense and lose their identity. What is the geologic or geophysical evidence that these oblique structures that are confined to the block northeast of the Hosgri fault system have any direct effect on its capability for generating large earthquakes?

QUESTION 7: Segmentation of the Los Osos fault zone (PG&E, 1988, p. 2-42 to 2-46; p. 2-125 to 2-128) is based chiefly on the topographic summit levels of hills adjoining the fault zone on the southwest. Summit levels are more often related to a number of variables other than fault activity rates. How were you able to separate and identify the tectonic contribution to relief and to reject the effects (on erosion and deposition rates) of: different rock types, the areal extent and maturity of drainage basins, selective mass wasting or slope failure in unstable rock units, changes in late Quaternary base level, and other variables?

QUESTION 8: Large (>M6) well-documented earthquakes that can confidently be tied to precisely-located aftershock sequences or to promptly and accurately mapped surface faulting comprise a relatively small data set. A significant part of this data set--probably well over 50 percent--shows faulting that propagates past fault bends, stepovers, intersecting structures, and other favored criteria for segmentation behavior; on the other hand, a few

fault segments, most of them associated with earthquakes smaller than magnitude 6, display a pattern of well-confirmed segmented behavior. What criteria were employed to decide that Los Osos, Hosgri, and San Luis Bay faults belong with the smaller set characterized by segmented fault behavior?

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