

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before The Atomic Safety & Licensing Board

In The Matter Of)
)
PACIFIC GAS & ELECTRIC COMPANY) Docket Nos. 50-275 OL
) 50-323 OL
(Diablo Canyon Nuclear Power Plant,)
Units 1 & 2))

INTERVENORS' REPLY TO THE STAFF
AND APPLICANT RESPONSE TO INTERVENORS' MOTION REQUESTING
THE ISSUANCE OF LICENSING BOARD SUBPOENAS

The Intervenors have requested the issuance of Licensing Board subpoenas for thirteen experts, each possessing first-hand knowledge directly relating to the seismic safety issues before this Licensing Board. For a variety of reasons, both the Staff and Applicant oppose the Intervenors' request. This reply addresses those arguments.

I.

A. The Intervenors have requested the issuance of Licensing Board subpoenas to five experts who are presently employees of the United States Geological Survey (USGS). The USGS consults to the NRC Staff on the Diablo Canyon licensing review. The Staff indicates that two USGS employees will be made available for cross examination at the hearing. ^{1/} These

^{1/} STAFF'S RESPONSE TO INTERVENORS' MOTION REQUESTING THE ISSUANCE OF LICENSING BOARD SUBPOENAS, at 4. [cited hereinafter as STAFF'S RESPONSE].

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two USGS employees, however, are not among the five experts identified in the Intervenor's motion. The Staff argues that issuance of Licensing Board subpoenas to compel the attendance and testimony of the five USGS employees identified in the Intervenor's motion violates the Commission's Rules of Practice.

Issuance of Licensing Board subpoenas to compel the attendance and testimony of consultants to the NRC is controlled by 10 CFR §2.720(h)(2)(i). That rule permits the Executive Director for Operations to designate the person(s) who will present the Staff position, and it prohibits the Licensing Board from requiring the attendance and testimony of any other NRC personnel ^{2/} except upon a showing of exceptional circumstances. The Staff argues that the Intervenor has failed to make the required showing. We disagree.

First, the discovery of a major active fault within two and one-half miles of the Diablo Canyon site has resulted in exceptional circumstances for the issuance of the operating license: issuance of the operating license depends on proof that Diablo Canyon, with very few modifications, ^{3/} can withstand an earthquake substantially greater than

^{2/} As used in §2.720, "NRC personnel" means persons acting in the capacity of consultants to the Commission. See, 10 CFR 2.4(p).

^{3/} The only significant modification to Diablo Canyon are structural modifications to the turbine building, (SER, Supp. 7, at 3-37, 3-38, and 3-45).

that for which it was originally designed and constructed. The original safe shutdown earthquake for the Diablo Canyon facilities corresponded to a 0.40g horizontal ground acceleration to be used for development of design response spectra. ^{4/} The safe shutdown earthquake now postulated by the Staff for the facility corresponds to a 0.75g horizontal ground acceleration. ^{5/}

The circumstances of this proceeding are exceptional because the Staff has significantly reduced the accepted margins of safety to approve the design and construction of Diablo Canyon. Diablo Canyon is second-rate in safety. The ACRS concedes as much:

Since there are expected to be significant differences between the nature of the ground motions close to a large earthquake and that at greater distances, to which most available data apply, the Staff relied heavily on the experience and judgment of its consultants, N.M. Newmark, an acknowledged expert in the field of earthquake engineering and structural design. On his advice, an effective zero-period acceleration of 0.75g was used to determine the free-field response spectra to be used in engineering analyses. These spectra were then reduced by varying amounts to obtain spectra for those structures in the plant having foundations extending over large areas. This reduction for the effects of building size is also based largely on judgment and experience rather than on extensive observations or analyses and has not heretofore been applied in the design of nuclear power plants.

^{4/} SER., Supp. No. 1, at 2-14.

^{5/} SER, Supp. No. 4, at 2.

The seismic design criteria proposed by the Staff permitted the use of damping factors for structures in accordance with Regulatory Guide 1.61 in place of the lower, and thus more conservative, values used by the Applicant in the original design. The Staff also permitted the use of as-built dimensions and masses, and material strengths determined from tests during construction, rather than the more conservative values used in the original design.

It is evident from the foregoing that the design bases and criteria utilized in the seismic reevaluation of the Diablo Canyon Station for the postulated Hosgri event are in certain cases less conservative than those that would be used for an original design. [Emphasis added] 6/

In view of these extraordinary circumstances that raise substantial, nagging questions regarding the safety of this facility, it is incumbent on the Licensing Board to assure compilation of the most complete record possible. No stone should be left unturned. The five USGS experts identified in the Intervenors' motion are uniquely qualified to assist the Board in making a comprehensive record. Messrs. McCullough and Wagner have done the actual field work in mapping the Hosgri-San Gregorio fault system. Both assisted in the preparation of the most recent USGS review for the NRC of the geologic data relevant to the Diablo Canyon site, dated

6/ Letter from Stephen Lawroski, Chairman, ACRS to the Honorable Joseph M. Hendrie, Chairman, NRC, dated July 14, 1978, at 2-3.

April 29, 1976. Their testimony will provide first-hand knowledge of facts material to establishing the structural definition of the Hosgri-San Gregorio fault system, i.e., the interrelationship of the various branches of the fault system. That interrelationship is important in assessing the maximum earthquake potential of the system - that is, how much of the fault could "break" in a single event.^{7/}

Dr. Joyner is a principle author of the USGS Circular 672, which describes the near field accelerations expected from a 7.5 magnitude earthquake. Dr. Joyner's work is the basis from which the Staff purports to derive the 0.75g horizontal acceleration used in the reanalysis of the Diablo Canyon seismic design.^{8/} Dr. Joyner's testimony will provide expert opinion on the peak acceleration to be expected in the near field of large earthquakes in the magnitude range 6.5-8.0.

Drs. Bonilla and Mark are principle authors of the USGS publication describing the empirical relationship between earthquake magnitude and fault length. The fault length-magnitude relationship was considered by USGS in designating 7.5 as the maximum earthquake potential of the Hosgri-San Gregorio fault system. The work of Drs. Bonilla and Mark

^{7/} See, Affidavit of Richard B. Hubbard, INTERVENORS' REQUEST FOR THE ISSUANCE OF LICENSING BOARD SUBPOENAS, at 3-8 [cited hereinafter as Affidavit of Richard B. Hubbard].

^{8/} See, Affidavit of Richard B. Hubbard, at 9-10.

suggest that the USGS may have understated the maximum earthquake potential of the Hosgri-San Gregorio fault system.^{9/}

In sum, Diablo Canyon raises exceptional safety concerns. The facility is sited next to a major fault and was originally designated for an earthquake substantially smaller than that designated as the safe shutdown earthquake. Instead of requiring modification, the Staff has significantly reduced safety margins to approve the design and construction of the facility. The circumstances justify the issuance of subpoenas to the USGS experts who are uniquely qualified to present expert testimony.

B. The Staff argues that the two USGS witnesses it will present are better qualified to present the USGS position because they, not Messrs. McCullough and Wagner, "participated in synthesizing the overall information into a bottom-line position."^{10/} That argument misses the point.

Messrs. Wagner and McCullough are called not to present the USGS bottom-line position, but to present their opinion of the structural definition of the Hosgri-San Gregorio fault system obtained from their first-hand field observations. The Staff-sponsored witnesses may well be qualified

^{9/} See, Affidavit of Richard B. Hubbard, at 9-10.

^{10/} STAFF'S RESPONSE, at 4.

to present the synthesized, USGS bottom-line position; however, they are poor substitutes for Messrs. McCullough and Wagner on matters relating to the McCullough and Wagner field observations. It is important for the record to reflect those first-hand observations.

The Staff suggests that "if after the presentation of the Staff's USGS witnesses the Board wishes to hear from Mr. Wagner and Mr. McCullough, the Staff will make them available." ^{11/} However, assurances that Messrs. Wagner and McCullough will be hovering in the wings, is simply not enough. Experience demonstrates that cross examination of the person with first-hand experience often results in disclosure of significant details that are filtered-out in synthesis and review. Cross examination of the Staff-sponsored witnesses may give no hint as to the significant information that Messrs. McCullough and Wagner could impart.

11/ See, Affidavit of Richard B. Hubbard, at 4.

C. The Staff asserts that the Intervenors failed to demonstrate that the participation of Drs. Bonilla, Mark and Joyner "would aid the Board in making its ultimate determination." The Staff fails even to mention the extensive proffer regarding the relevance of these expert's contribution to the seismic safety issues before this Licensing Board. ^{12/} Intervenors submit that an adequate showing has been made, and request the Board to reject the Staff's unsupported assertion.

II.

A. The Staff argues that the request to subpoena Drs. Trifunac and Luco should be denied because, first, the Intervenors have failed to make a showing of extraordinary circumstances, and second, they are protected by the ruling in Aeschliman. ^{13/} Intervenors have already outlined the

^{10/} See, Affidavit of Richard Hubbard, at 9-13.

^{11/} Aeschliman v. U.S. Nuclear Regulatory Commission, 547 F.2d 622, 631 (D.C. Cir. 1978), rev'd on other grounds sub nom. Vermont Yankee Nuclear Power Corp. v. NRDC, ___ U.S. ___, 55 L. Ed. 2d 460 (1978).

extraordinary circumstances surrounding this proceeding. ^{14/}

In light of these circumstances and the Board's duty to make a definitive finding of safety, every effort should be made to call upon those who can materially assist the Board in its task. No two experts are better qualified to do so than Drs. Trifunac and Luco. Both are acknowledged experts in the field of earthquake engineering and both served as consultants to the ACRS during its assessment of the Diablo Canyon seismic design basis. And of particular note here, both have published substantial criticisms of the Staff and Applicant reanalysis. ^{15/} Of the design spectrum used for the reevaluation of the Diablo Canyon facility, Dr. Luco has stated:

In my opinion, the free-field design spectrum used for re-evaluation of the Diablo Canyon Nuclear Power Plant does not reflect the strong motion at the site for a 7.5 magnitude earthquake at an epicentral distance of 5 kilometers, but rather the motion for a 6.5M earthquake at that distance. ^{16/}

^{14/} Supra, at 3-4. There is some doubt as to whether Drs. Trifunac and Luco fall within the category of people for whom a showing of "exceptional circumstance" must be made to authorize issuance of a subpoena. 10 CFR 2.4(p) does not include consultants to advisory committees as "NRC personnel" for the purpose of §2.720. The point, however, is moot because exceptional circumstances can be demonstrated here.

^{15/} See, Affidavit of Richard B. Hubbard, at 14-18.

^{16/} Ibid, at 15.

Regarding the Staff's application of the Tau effect and damping in the seismic reanalysis, Dr. Trifunac observed at a 1976 ACRS subcommittee meeting:

.... This is the first time that I have had the opportunity to see a whole sequence of procedures that are impressing me as going in one direction which is reducing something that we would call effective acceleration. 17/

In a recent decision, the Commission reminded the Staff of its obligation to implement the Commission's open-door policy about differing professional opinions, with particular focus on the Staff's testimony at Licensing Board hearings. 18/ That reminder underscores the Commission's concern that consideration of scientific opinions, differing from the Staff's position, be reflected in the Commission's decision. That concern is relevant to the issuance of Licensing Board subpoenas to Drs. Trifunac and Luco.

For over two and one-half years, Drs. Trifunac and Luco have offered significant and well-informed criticisms of the Staff's and Applicant derivation of design response spectra for the reanalysis of Diablo Canyon's seismic design. Issuance of Licensing Board subpoenas to obtain the testimony of Drs. Trifunac and Luco is consistent with the Commission's concern for development of a record that reflects competing scientific viewpoints.

17/ Affidavit of Richard B. Hubbard, at 12-18.

18/ In the Matter of Carolina Power & Light Company, Shearon Harris Nuclear Power Plant, Units 1, 2, 3 & 4, CLI-78-9, 8 NRC _____ (Slip Op., at 3).

B. The Staff argues that issuance of Licensing Board subpoenas to Drs. Trifunac and Luco is barred by the decision in Aeschliman.^{19/} In that case, an intervenor requested the Licensing Board to permit discovery from individual ACRS members in order to probe certain statements in an ACRS letter to the Commission. The Court agreed with the intervenor that further explanation of the ACRS letter was necessary, but held that discovery from individual ACRS members was not the proper way to obtain it:

Turning to the propriety of discovery directed to individual ACRS members and ACRS documents, we conclude it was not error to deny these requests. ACRS' unique role as an independent "part of the administrative procedures in chapter 16 of the Act," supra, is sufficiently analogous to that of an administrative decision-makers to bring into play the rule that the "mental processes" of such a "collaborative instrumentality of justice" are not ordinarily subject to probing. United States v. Morgan, 313 U.S. 409, 422, 61 S.Ct. 979, 55 L. Ed. 1429 (1941). This rule is particularly appropriate in light of the ACRS' collegial composition such that no individual may speak for the group as a whole. 20/

The rule against probing the "mental processes" of independent administrative decision-makers, invoked by the Court in Aeschliman, is not applicable here. In Aeschliman, the issue was whether the Licensing Board should issue a subpoena to a member of the ACRS to explain an ACRS position. Here, however, the issue is whether the Licensing Board should

19/ Aeschliman v. U.S. Nuclear Regulatory Commission, supra, at

20/ Aeschliman v. U.S. Nuclear Regulatory Commission, supra, at 631.

issue a subpoena to a consultant to the ACRS in order to obtain his expert opinion. Neither Dr. Trifunac nor Dr. Luco is a member of the ACRS, and regardless of the ruling in Aeschliman, neither is in a position to speak on behalf of the ACRS. Each, however, is in a position to provide essential factual and expert testimony bearing directly upon the safety issues in controversy in this proceeding.

Furthermore, in Aeschliman, there was an adequate substitute to conducting discovery on individual ACRS members. The Court ordered the NRC to return the ACRS letter to the ACRS for clarification. Here, however, there is no substitute to obtaining the testimony of Drs. Trifunac and Luco for the record. With the exception of the Staff and Applicant experts, no qualified scientists have studied in detail the derivation of the design response spectra for Diablo Canyon as have Drs. Trifunac and Luco.

Finally, if for reasons of comity, this Board is reluctant to subpoena Drs. Trifunac and Luco, Intervenors suggest that the Licensing Board invite the two experts, by letter, to attend and present testimony.

III.

A. Of the remaining six witnesses, four are associated with Universities, ^{21/} one with a joint government-university

^{21/} Dr. El: Silver, University of California-Santa Cruz; Dr. Clarence Hall, Jr., University of California; Dr. William Dickinson, Stanford University; and Dr. James Brune, University of California-San Diego.

research institute, ^{22/} and one with a private corporation. ^{23/}
 All six have indicated that they are prepared to offer testimony, but for a variety of reasons, are reluctant to appear on behalf of the Intervenor. Each of these six witnesses is in a position to provide essential factual and expert testimony bearing upon the safety issues in controversy in this proceeding.

Dr. Eli Silver has first-hand field experience and directed the first USGS scientific exploration of the fault system following the disclosure of its existence by Shell Oil Company geologists. He has studied extensive aeromagnetic data in order to determine whether there is continuity in the Hosgri-San Gregorio fault system. ^{24/} Dr. Silver's testimony will provide direct knowledge of facts material to establishing the structural definition of F, and the potential for movement on, the Hosgri-San Gregorio fault system.

Dr. Clarence Hall has conducted substantial field work at the southern end of the Hosgri-San Gregorio fault system. Dr. Hall draws conclusions from his detailed work with stratigraphic observations about the amount and nature of historical displacement along the southern end of the fault. ^{25/}

^{22/} Dr. W. Gawthorp, Cooperative Institute For Research In Environmental Sciences, University of Colorado-NOAA.

^{23/} Dr. Stephen Graham, Chevron.

^{24/} See, Affidavit of Richard B. Hubbard, and Attachments B & F.

^{25/} Ibid, at 3-7, and Attachments C, H & I.

Drs. Graham and Dickinson conducted similar studies of the northern end of the fault. ^{26/} As described in the Affidavit of Richard B. Hubbard accompanying the Intervenor's original motion, the testimony of these three experts provides first-hand knowledge of facts material to establishing the structural definition of the Hosgri-San Gregorio fault system and the potential for movement in the present.

Dr. W. Gawthrop, formerly with USGS, has studied the location of the 1927 earthquake (7.2 magnitude), and its relationship to the Hosgri-San Gregorio fault. ^{27/} Dr. Gawthrop's testimony will be directly related to establishing the present potential for movement along the fault system.

Dr. James Brune has prepared work examining the phenomenon of focussing high frequency energy by a propagating source, such as a fault. Dr. Brune testified before the ACRS, at the invitation of the ACRS. His testimony, at that time, established that the phenomenon of focussing is relevant to assessing the adequacy of Diablo Canyon's seismic design: ^{28/}

In the case of the Diablo Canyon nuclear reactor, given the assumptions that the San Simeon-Hosgri fault system is a continuous active fault coming within 5 km

^{26/} Ibid, and Attachments D, E & G.

^{27/} SER., Supp. 4, at C-19 & 20.

^{28/} See, Affidavit of Richard B. Hubbard, at 13-19 and Attachment M.

of the Diablo Canyon nuclear power plant, focussing by rupture propagation (from northwest to southeast) could lead to anomolous high accelerations, possibly greater than 2g. At the present time, it is not possible to say what the probability of such high accelerations is. Many of the factors necessary for estimating the probability are being intensively studied and should be much better understood in a year or two.

Neither the Staff nor the Applicant has adequately addressed this matter. ^{29/}

B. The Staff argues that the request to subpoena the six experts listed above should be denied because, first, upon the proper showing, Intervenors can command their appearance by requesting subpoenas and, therefore, the request for Licensing Board subpoenas is but a "thinly veiled device to obtain financial assistance from the NRC;" and second, the Intervenors failed to demonstrate that appearance of the witnesses is either necessary or would be beneficial in the development of the record. ^{30/}

We agree: the Commission has no obligation to finance the Intervenors. However, the Commission does have an obligation to provide reasonable assurances that the operation of Diablo Canyon will not unduly jeopardize public health and safety. Power Reactor Development Co. v. International

^{29/} Ibid, at 19.

^{30/} STAFF RESPONSE, at 5-7.

Electricians Union, 367 U.S. 396 (1961).

Substantial and nagging safety concerns surround Diablo Canyon. ^{31/} Each of the thirteen witnesses identified in the Intervenor's motion is uniquely qualified to provide facts and expert testimony which will materially assist the Board in resolving contested safety issues. In view of these exceptional circumstances, safety concerns override concerns for the purse and fully justify issuance of the requested subpoenas.

However, should the financial concerns pose a hurdle, Intervenor's request the Licensing Board to subpoena the above mentioned experts, and permit cross examination by all parties, with the understanding that Intervenor's will bear all costs.

B. The Staff argument that the Intervenor's failed to demonstrate that participation by Drs. Silver, Hall, Graham, Dickinson, Gawthrop and Brune would aid the Board in making its ultimate decision is an unsupported argument. The Staff fails to address the Intervenor's extensive proffer. We request the Board to reject this argument.

III.

A. For its part, the Applicant argues that (1) the Affidavit of Richard B. Hubbard should be struck; (2)

^{31/} Supra, at 6.

Aeschliman bars the issuance of subpoenas to Drs. Trifunac and Luco, the ACRS consultants; (3) the request violates the Commission's rule against providing financial assistance to Intervenor; and (4) the Applicant's rights would be violated by issuance of the requested subpoenas. Arguments (2) and (3) have previously been addressed above. We here address arguments (1) and (4). ^{32/}

B. The Applicant asserts that the Affidavit of Richard B. Hubbard should be struck because it contains hearsay and the affiant is not qualified to testify on matters contained in his Affidavit. The Applicant's argument misses the point; the point is that Mr. Hubbard's Affidavit is offered to demonstrate the relevance and materiality of the testimony expected to be obtained from the thirteen experts. The Affidavit is offered to support the request for the issuance of subpoenas. It is not offered to support findings of fact related to the issues in contention. Certainly, Mr. Hubbard's technical background qualifies him to describe generally the relevance and materiality of the testimony expected to be obtained. ^{33/}

^{32/} RESPONSE OF PACIFIC GAS & ELECTRIC COMPANY TO INTERVENORS' REQUEST FOR THE ISSUANCE OF LICENSING BOARD SUBPOENAS, [cited hereinafter as APPLICANT'S RESPONSE].

^{33/} See, e.g., In the Matter of Public Service Co. of Oklahoma, et al., (Black Fox Station, Units 1 & 2), Licensing Board Order, September 8, 1978.

Additionally, Applicant's insistence that the rule against hearsay testimony be strictly applied is contrary to accepted administrative procedure. This is particularly true in a case where, as here, the affidavit is offered to describe generally the testimony expected to be obtained from other experts.

C. The Applicant complains that issuance of the requested subpoenas will prejudice its rights by denying it the opportunity to prepare adequately for cross examination of the experts. The Applicant gives the impression that it is in the dark with respect to the testimony expected to be obtained from the thirteen experts and argues that depositions would be useless. ^{34/}

The Applicant has misled the Board. The Applicant or their consultants are intimately familiar with the work of each of the thirteen experts. Drs. Trifunac and Luco, over the course of the last two years, have submitted extensive written comments to the ACRS regarding the derivation of the design response spectra used in reanalysis of Diablo Canyon. Certainly, the Applicants have studied those comments extensively.

Dr. Hall, in June, 1976, and Dr. Brune, in June, 1977, presented testimony to the ACRS and responded to questioning

^{34/} APPLICANT'S RESPONSE, at 5.

from members of the ACRS. The Applicant was there. Moreover, documents obtained through discovery indicate that this Spring, the Applicant was concerned about Dr. Brune's focussing phenomenon and was well aware of Dr. Hall's views on the Hosgri-San Gregorio fault system.

Those same documents indicate that the Applicant has continuously monitored the opinions of various scientists regarding the Hosgri-San Gregorio fault, including Drs. Silver, Graham, Hall, Gawthrop, Dickinson and McCullough.^{35/} Nor is there any reason to believe that the Applicants are not fully aware of the work of Drs. Bonilla, Mark and Joyner. The work of these experts was cited as the basis for the USGS conclusion in SER, Supp. 4, issued in May, 1976.

Finally, it is reasonably evident from the Affidavit of Richard B. Hubbard and the work attached thereto what testimony would be expected from these experts. Given the arsenal of seismic and geologic consultants on the Applicant's payroll, their familiarity over the course of 2 years with the work of all thirteen experts, and the availability of depositions, the Applicant complaint that it is prejudiced is not supportable. Moreover, following the testimony of these witnesses, the Applicant may take the opportunity to submit rebuttal testimony.

^{35/} Drs. Wagner and McCullough have worked together on the Hosgri project for USGS.

One final note: the Applicant implies that Applicant alone is at a disadvantage for not having testimony pre-filed by the thirteen witnesses. The Applicant is no more at a disadvantage than the Intervenors. In fact, given the resources at his command, he is better off.

IV.

For the reasons set forth above, Intervenors request that its motion be granted. In the alternative, Intervenors request that the thirteen experts be subpoenaed with the Intervenors bearing all costs and that cross examination be permitted by all parties.

Respectfully submitted,

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SEPTEMBER 23, 1978

ORIGIN AND DEVELOPMENT OF THE LAMPAC-SANTA MARIA PULL-APART BASIN AND ITS RELATION TO THE SAN SIMEON-HOSGRI FAULT, CALIFORNIA

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A speculative model is proposed to account for the distribution of Tertiary igneous, sedimentary, and volcanoclastic rocks that lie within the Lampac-Santa Maria region, Santa Barbara County, California. Comparisons of lithologies and stratigraphic sections support the hypothesis that the Tertiary Lampac-Santa Maria basin is a pull-apart structure. It is proposed that the Santa Maria River and Honda faults are part of the same transform or right-lateral fault system and, before the pulling apart of the Lampac-Santa Maria basin, were a single fault or fault system. The formation of the pull-apart basin began following deposition of the Sespe-Lospe, Vaqueros, Rincon, and Obispo (=Trancuillon) and part of the Point Sal rock units. Of particular note is the fact that approximately 400 m of middle Miocene volcanoclastic rocks are missing immediately southwest of the Santa Maria River fault, but are present 35 to 45 km further to the southwest and on the southwest margin of the Lampac-Santa Maria basin.

Because relatively incompetent Franciscan rocks forming the "floor" of the basin apparently were easily stretched, little volcanic or intrusive activity occurred contemporaneously with the pull apart. Near the completion of the pull-apart, sediments making up the Point Sal and younger Tertiary formations flooded the basin. Finally, following deposition of the late Tertiary sediments, the western part of the basin was displaced nearly 20 km to the northwest along the San Simeon-Hosgri fault.

HOSGRI FAULT ZONE; STRUCTURE, AMOUNT OF DISPLACEMENT, AND RELATIONSHIP TO STRUCTURES OF THE WESTERN TRANSVERSE RANGES

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The geology of the offshore region along the continental margin of south central California has been mapped using geophysical and stratigraphic data derived from power plant licensing studies and petroleum exploration. Within this area, the near shore Hosgri, San Simeon, and Sur faults form the principal boundaries between the onshore uplift of the southern Coast Ranges and the offshore basins. The main part of the Hosgri fault, the most southerly of this series, defines a linear zone that strikes N25W and extends over a 105 km distance between the vicinities of Point Sal and Cape San Martin. Although the Hosgri fault zone served as a boundary structure with predominantly vertical displacements during middle Tertiary time, several lines of evidence indicate that late Tertiary movements along the central reach of this fault have been accommodated, at least in part, by right oblique slip. Stratigraphic evidence based on comparison of the section penetrated by the "Oceano No. 2" well, located west of the fault, with sections east of the fault, indicates a maximum of about 10 to 20 km of right lateral slip along the Hosgri zone since Miocene time. The lateral slip is accommodated in folds and reverse slip splays at the north and south ends of the fault zone. Splay faults at the south end of the Hosgri, and both faults and folds in the ground farther south, bend toward and mutually interfere with faults and folds extending seaward from the Transverse Ranges province to the east. A pattern of interference, rather than truncation of one system by the other, apparently results from mutual accommodation between the right lateral movements of the Hosgri system and the left lateral movements of the Transverse Ranges system.

ARE THE SAN GREGORIO AND HOSGRI FAULT ZONES A SINGLE FAULT SYSTEM?

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Many lines of evidence lead to the conclusion of over 100 km of lateral offset along both fault zones since early Miocene. Hamilton and Willingham give evidence for only 10 to 20 km of near-vertical right slip on the Hosgri, which allows the possible application of 80 to 100 km of lateral offset occurring in Miocene time. Interestingly, the results of global plate reconstructions suggest average Pacific-America shear was nearly parallel to the present San Gregorio-Hosgri trend in early to middle Miocene. No unanimity exists as to whether or not the San Gregorio and Hosgri faults connect. The critical region is between Monterey and just south of Pt. Sur. Any projection of the San Gregorio south of Monterey requires the fault to bend SE, and joining with the Hosgri involves the least bending. Mapping a complex coastal and nearshore fault system is difficult but we hope to have a clearer picture of this intersection by the time of this symposium as a result of detailed aeromagnetic surveys that have been flown but not yet released. If these faults do indeed have over 100 km of Neocene right slip, they are most visibly interpreted as part of a continuous shear surface through the crust and upper mantle.

P. D. 00973

Abstracts of Symposium on the San Gregorio - Hosgri fault system" April 1977
Cordilleran Section Meeting of the Geological Society of America.

STRATIGRAPHIC CONTRASTS ACROSS THE SAN GREGORIO FAULT, SANTA CRUZ MOUNTAINS, WEST CENTRAL CALIFORNIA

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The onshore trace of the San Gregorio fault extends from coastal exposures east of Año Nuevo Point northwestward for 27 km (16 mi) to the coast near San Gregorio. This fault has juxtaposed two major tectonic blocks with markedly different stratigraphic sequences, suggesting that the fault has extensive lateral displacement.

In the Pigeon Point block southwest of the San Gregorio fault, porphyritic silicic rocks may form part of the basement; they are overlain by at least 2,600 m (8,500 ft) of elastic strata of Late Cretaceous age. Cretaceous strata are not present in the La Honda and Ben Lomond blocks northeast of the fault where more than 10,000 m (33,000 ft) of Paleocene to Pliocene rocks rests on a pre-Tertiary granitic basement. Paleocene and Eocene rocks are not present in the Pigeon Point block. Oligocene (Tortonian) and middle Miocene (Relizian and Luizian) strata occur in both tectonic blocks, but they differ in lithology, fauna, and bathymetry on opposite sides. A thick upper Miocene to lower Pliocene mudstone section in the La Honda and Ben Lomond blocks is missing west of the fault.

APPARENT OFFSETS OF ON-LAND GEOLOGIC FEATURES ACROSS THE SAN GREGORIO-HOSGRI FAULT TREND

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The San Gregorio-Hosgri fault trend, roughly coincident with the present central California coastline and a component of the San Andreas fault system, may have experienced about 100 km of Neogene right-slip. Evidence for right-slip consists of possible pairs of offset tectonic features, including (1) nearly identical Tertiary sequences at Point Reyes and in the southern Santa Cruz Mountains, (2) similar Cretaceous strata of the western Santa Cruz Mountains and northern Santa Lucia Range, (3) the structural contact between granitic basement and Franciscan complex north of Bodega Head and in the northern Santa Cruz Mountains, (4) tectonic slabs of Kspar-bearing sandstones within the Franciscan complex near Point Sur and Camorra, (5) Franciscan-derived Miocene sandstones near Point Sur and potential source terraces to the south, and (6) Mesozoic ophiolite and overlying Tertiary sections near San Simeon and Point Sal. The suggested right-slip is definitely post-early Miocene and probably post-late Miocene. Because the San Gregorio-Hosgri fault trend intersects the San Andreas fault offshore south of Bolinas, the total apparent offset of granitic basement along the San Andreas fault is actually the sum of offsets on the San Gregorio-Hosgri and San Andreas faults. Comparison of nine-displacement curves demonstrates that these two faults account for much of the post-Oligocene displacement between the Pacific and North American plates. Recognition of Neogene San Gregorio-Hosgri right-slip thus reduces considerably the apparent magnitude of right-slip along an early Tertiary proto-San Andreas fault.

SLIVERING OF THE SALINIAN BLOCK ALONG THE PALO COLORADO-SAN GREGORIO AND ASSOCIATED FAULT ZONES

GREENE, H. Gary, U. S. Geological Survey, Menlo Park, California 94025

Displacement along faults within the northwest-trending Palo Colorado-San Gregorio and Monterey Bay fault zones and along the newly named Ascension fault may provide an explanation for the apparent discrepancy in total offset along the San Andreas fault system in central and southern California. Recent seismicity indicates that the first two fault zones are active and are undergoing right slip. This activity probably reflects stress release along the San Andreas fault system of which these zones are a part.

Right slip within these fault zones has slivered the Salinian block. A probable result of this slivering is the production of a serrated rather than a linear western margin for the block. As the Salinian block moved northwestward along the San Andreas fault, this serrated margin would have been fragmented, with fragments and slivers of basement rocks pushed ahead of or carried along seaward of the block. A model for the tectonic slivering and elongation of the Salinian block is proposed on the basis of the sense of movement and pattern of faulting observed in the central part of the block. Right slip along the Palo Colorado-San Gregorio fault zone and older (pre-Pliocene) Ascension fault probably has offset the lower part of Monterey Canyon almost continuously for the past 10 m.y. These displaced segments were exhumed during the Pleistocene and exist today as Pioneer and Ascension Canyons. The present distance between the two canyons, 110 km, is a measure of offset along these faults since middle Miocene time. This model also provides an alternate explanation for the origin and development of submarine canyons that head on the outer

P D 00972

PACIFIC GAS AND ELECTRIC COMPANY
GENERAL COMPUTATION SHEET

SUBJECT Current Schedule of activities

MADE BY	DATE	CHECKED BY	APPROVED BY
May	1	SER	Issued (Continued in file) provide it with (4/21/19)
May	17/13/19	ACRS	Sub Comm
June	15	ACRS	(Assumed)
Sep	12		Beginning of Public Use
	1		Also known as
Oct	12		Partial. Pub. Use

Attenuation of Activity rate
Probability

Bruce - Valuable to produce a summary
of report has been done re prob - also
has a letter 7/5/19

Had to talk to [unclear] in USGS re

Frank McNewman on [unclear] of U.S.G.S.

- has been told to be held to the
he used in drawing his conclusions - 5/1/19
attended - I seemed to agree @ reliability of Walker's

Warren Springs - [unclear] fault - some
to be noted

GENERAL COMPUTATION SHEET

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4. Incident 52 notes -

Incident type report

to file and - 1

(7)

5. Creation of margin - M. J. Lapp
- amount

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M. J. T. - Length of run

Hamilton - Oglala station - first mile

J.H.C. - Treatise on various part studies
- also (notes) put various matter together
in notebook form
2 sep books! 1) Rel of US on attack
probability

Brown - Prep for ¹⁹²⁵ 1st course 5/17/24

1. Lecture together on various earlier
2. Lecture rehearsal on 16 & 17

Who is to think parts to make presentation

SS - focusing may need more notes

1. Sameer Loren - (41) 3 sessions of
2 out of 3 see to top have checked to NRC
- 2nd 1/2 hour committed to having operator
- 1 - LBH - Presentation

2. Instrumentation - Should be on order
in ACRB out some notes - Plan to
present

3. Treatise
 - A Subject verification treatise
 - B General how NRC is explained
 - C Large structure treatise

GENERAL COMPUTATION SHEET

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SUBJECT _____

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These files -
Bureau files - some all in (all
are based on what Dept. says)

(*) S.S. - D. Lenthart still reviews HOSG 2' SA copy
and research!
(2) if CSJ make in of course re statement
of substance - work
analysis -

What steps do we take now?
Mooi again

Res

Seiss
Frash
Epps -
Filed out where TEL stand
Explosive tests
USP - Additional statement re purpose
Lewin - make DHH
Scott Lyman - Phone

GENERAL COMPUTATION SHEET

SUBJECT: D.C. Consultants Meeting

MADE BY RFB DATE 3-21-73 CHECKED BY _____ APPROVED BY _____

JUL - Current Status

90 mile fault - PG&E for
Buckner Bluffs - Pt Sal
5-15 km long; 2 km wide

Info from additional sources -

(*)

1. Dave H. Kellogg - he can manage
efforts - worked on slope off "45552"
off Pt Sal

2. B. ... - there were info
that could be obtained from ...
has been faulted ...
which - ...
could ...
measurement ...
to Kellogg to develop - should be ...
- slope might have to be prepared

3. FUGRO - extract ... to do
...
these maps - Dept in ...

Other data in same (almost) area - ...
... that "45552" ...
...
more important structures than ...
been ...

RFB

AGENDA

Diablo Canyon Consultants Update Meeting

March 21, 1978 - Rm. 1145, 245 Market - 8:30 A.M.

- 1. Introduction - (RVB)
- 2. Current Statue of Licensing
 - a. Schedule (JBH)
 - b. NRC/ACRS issues
 - ③ Structural/Equipment response (VJG)
 - ① Ground Motion Parameters } (GCL)
 - ② Probabilistic studies }
- 3. SRP Program (HJH) - *Is any work far enough along to use in current licensing? - to be assessed at next Mtg*
- 4. Consultants Reports on State-of-art developments
 - a. Geology
 - b. Seismology
 - c. Soil-Structure Interaction
 - d. Structural Dynamics

(*)

5. Future Strategy (MHF, JBH, RVB)

- a. NRC/ACRS Concerns
- b. Public hearings
- c. Operation

What do we expect re consultants?
ACRS Subgroup
Full
Focusing Commission at San Simon
Extension - 2000

Other:

FBI / - Need to consider how to respond -
skagit / - Crane Furbush & Norton will discuss.
Timing a la Okronht or SICS
Contentions re 3D size. - Silver? ✓
LNG siting near Diablo Canyon.

(*)

cc: Attendees

ITEMS WHICH MAY STILL BE TROUBLESPOT

- ① HOSGRI-MAGNITUDE CAPABILITY
- ② DAMPING
- ③ DECOUPLING
- ④ POLAR CRANE

LEM

P. D 00964

55
55

Call from
D.H.H.

(*)

SEK by Stepp - Presumes he is aware of Grand Dickerson 110 km of ship. Concern re what happens

2. Sibbles - report for Santa Barbara Co. re LNG siting. Look into ED potential & plate last deal in 1927 event & probably will be treated. - Head of to via an atty. Suspicion is will suggest large ED's in channel.

1. Ogle Cape - Del OSW Legal Fund early March - Side O&G along W coast. Insurance info - In part has logs from St. Anso Nuevo well that dispute 110 km ship thing - Would

(301) 492-7591

RVB → Chuck @ Dennis re Stepp program - If seems advisable - will have D.H.H. call Stepp

Call to D. Allison re advisability of having D.H. call Stepp on
recent information relative to Hosgri. Allison says he has
a list of items for Stepp to accomplish in next month

1. Answer ^{to} ~~interrogatories~~ (1 yr old)

Respond to
2. ~~Geoscientific~~ question, ^{need for} more exploration
~~staff~~ (by Staff)

Summary of key points made at
3. Seminars that various people ^{from} staff
have been to

4. ^{Report to} Dennis letter on focusing
Summarizing results of probability work
5. Probability

Dennis then said we should have received a will receive a
Report from Page & Thompson
re geoscientific dating work done
@ Stanford - Pac R. motion
greater in recent
consistent w/ Clarence Hall

30 4 times present rate
memo - subject A.C.R. 5 Consultant report

P D 00962

3/30/78 - D.S. hasn't talked to Stepp yet

Diablo Canyon Consultants Update Meeting
PG&E, 3-21-78

<u>Name</u>	<u>Representing</u>
J. O. Schuyler	PG&E
L. E. Malik	URS/John A. Blume & Assoc.
CA Cornell	self
M. V. Williamson	PG&E
ARIE SCHUURMAN	PG&E
Erwin Wollak	P.G. & E.
R L Kelman	PG&E
VICTORIA C. WRAY	PG&E.

Diablo Canyon Consultants Update Meeting
 PG&E, 3-21-78

Name	Representing
H. J. Howland	PG&E
GEORGE LEUFESTY	PG&E
R.V. Bettinger	"
Grant W. Smith	Univ. of Washington
John B. Hoch	PG&E
Richard H. Jelma	Stanford University
Mason T. Hill	Consulting Geologist
George Oates	Consulting Biologist
D.H. Harris Horn	Earth Sciences Assoc.
Bruce Norton	Law Office
Phil CRANE	PG&E Law
Malcolm Furber	PG&E Law
C. W. Shaddockford	PG&E
John A. Blume	URS/Blume Engineers
Dick Williamson	Earth Sciences Assoc.
Bruce Abbott	U.C. Berkeley
John Lyman	U.C. Berkeley
Vince Gies	PG&E
Harlan Shaw	PG&E
W.K. Brunot	PG&E
F.F. Mautz	P.G. + E OVER

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