

PACIFIC GAS AND ELECTRIC COMPANY

PG&E + 77 BEALE STREET, 31ST FLOOR • SAN FRANCISCO, CALIFORNIA 94106 • (415) 781-4211

JOHN C. MORRISSEY
VICE PRESIDENT AND GENERAL COUNSEL

March 10, 1978

MALCOLM H. FURBUSH
ASSOCIATE GENERAL COUNSEL

CHARLES T. VAN DEUSEN
PHILIP A. CRANE, JR.
HENRY J. LAPLANTE
RICHARD A. CLARKE
JOHN B. GIBSON
ASSISTANT GENERAL COUNSEL

GILBERT L. HARRICE
GLENN WEST, JR.
CHARLES W. THIBODELL
DANIEL E. GIBSON
JOSEPH I. KELLY
HOWARD V. GOLUB
EDWARD J. MCGANNAY
ARTHUR L. MILHAM, JR.
ROBERT O'NEAL
DAN GREGORY LUSBOCK
JACK F. FALLIN, JR.

SENIOR COUNSEL
JOSHUA BARILEY
ROBERT L. BONDON
LEIGH B. CARRIGY
SEAN R. GENTON
DARY P. ENGINAR
DONALD ERICSSON
DAVID C. GILBERT
ANNETTE GREEN
ROBERT L. HARRIS
KERRIT Q. KUSITE
THEODORE L. LINDBERG, JR.
RICHARD F. LODGE
HARRY W. LONG, JR.
RICHARD M. MORG
J. MICHAEL REICHENBACH
INOP E. BANSLOW
BUE ANN LEVIN SCHIFF
DAVID J. WILLIAMSON
BRUCE R. WORTHINGTON
J. PETER BAUMGARTNER
STEVEN P. BURKE
BERNARD J. DELLASANTA
WILLIAM W. EDWARDS
JOSEPH J. ENGLETT, JR.
JOHN H. FOTE
BARBARA A. GOSSE
PETER W. HANSEN
JUAN M. JARD
F. DONALD LAURMEINER
MERCE C. LISSON
JAMES C. LUDSON
MICHAEL L. WEISS
DOUGLAS A. DOLEBY
ROBERT Q. RICELEY
SHIRLEY A. SANDERSON
JACK W. SHUCK
SHIRLEY A. WOOD

3/10/78

Mr. Brad Whitman, Assistant Chief
Pollution Control Section
U. S. Department of Justice
Room 2625
Washington, D. C. 20530

Re: NRC Dockets 50-275, 50-323

Dear Mr. Whitman:

Counsel for the NRC Staff have advised us that the Justice Department is investigating a request from an unnamed citizen concerning our disclosure of the existence of the Hosgri Fault. On March 8, 1978 we received a copy of a letter to you dated December 12, 1977 from Thomas J. McTiernan, Director of the NRC's Office of Inspector and Auditor, together with a list of documents supplied by various offices of the NRC. Although so far as I know we have received no request for information pertinent to your inquiry, it occurred to me that your investigation would be assisted by examination of the following two documents, copies of which are enclosed:

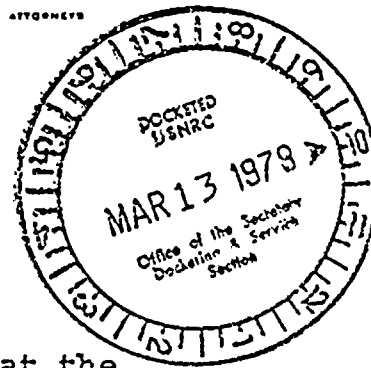
1. Statement of the Pacific Gas and Electric Company before the Subcommittee on Energy and the Environment of the House Committee on Interior and Insular Affairs, June 30, 1977.
2. A response we made in July 1977 to a data request from the California Public Utilities Commission concerning Diablo Canyon.

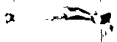
A transcript of the proceeding before the House Subcommittee is available as is a printed copy of the Subcommittee Report.

Very truly yours,

Philip A. Crane, Jr.

Enclosures
CC w/encs.: Mr. Thomas J. McTiernan
Service List

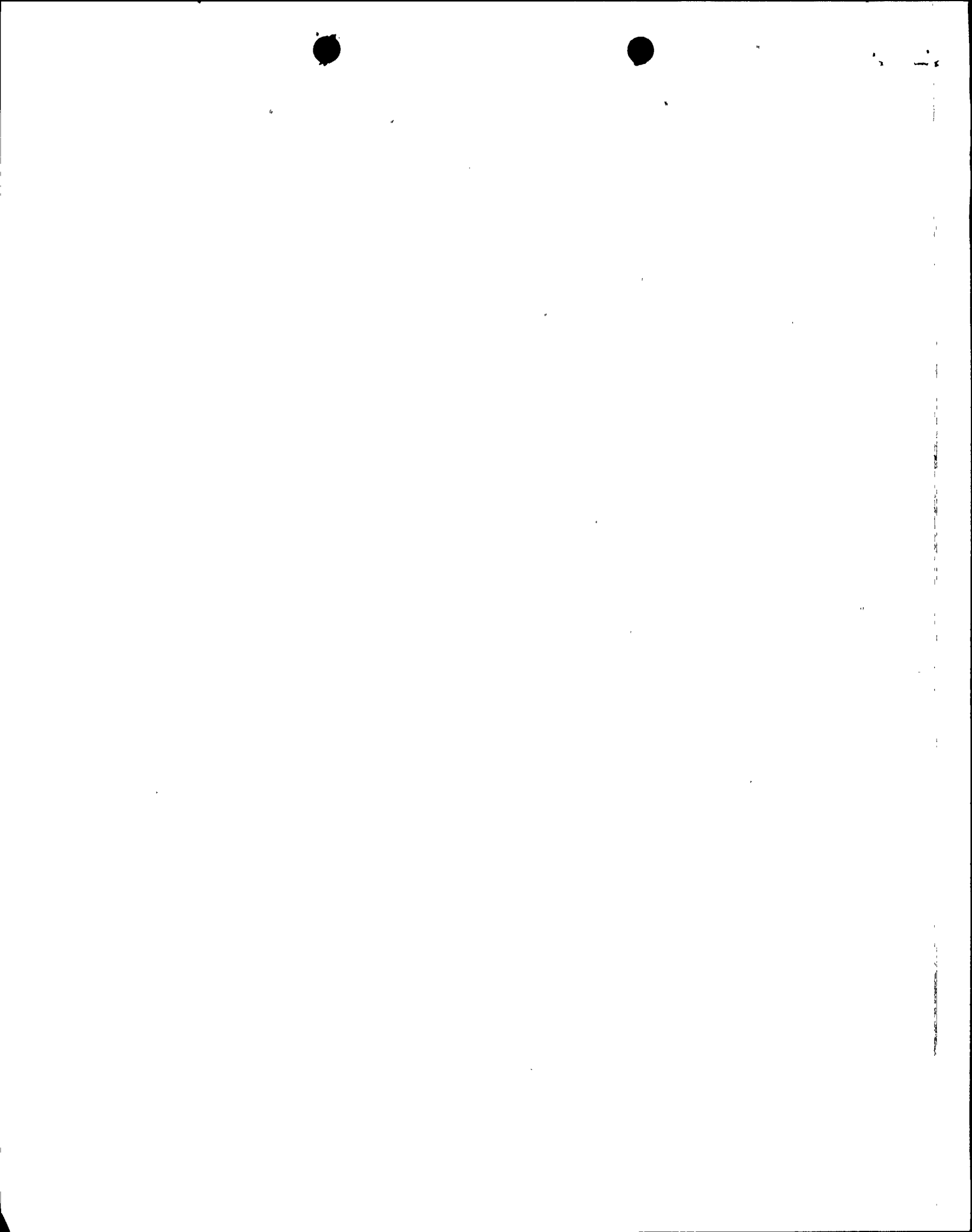




STATEMENT OF THE
PACIFIC GAS AND ELECTRIC COMPANY

BEFORE THE
SUBCOMMITTEE ON
ENERGY AND THE ENVIRONMENT
OF THE
HOUSE COMMITTEE ON
INTERIOR AND INSULAR AFFAIRS

JUNE 30, 1977



Mr. Chairman, I am Malcolm Furbush, Associate General Counsel of Pacific Gas and Electric Company. Accompanying me today are Mr. Barton Shackelford, Senior Vice President, and our Chief Civil Engineer, Mr. Richard Bettinger. Also here are two of our consultants on geologic and seismic matters: Mr. Douglas Hamilton and Dr. Stewart Smith.

We wish to inform your Subcommittee of the great care which has been and is being given to the design of our nuclear power plant at Diablo Canyon to resist earthquakes. We have no doubt as to the safety of this facility.

To put Diablo Canyon into perspective, let me first briefly describe our service territory and the problems we confront as our area suffers under an unprecedented drought.

PGandE's service territory covers more than 94,000 square miles in northern and central California with a population of more than 8 million. It includes the San Francisco Bay Area and the Central Valley which is the source of much of California's agricultural production. The area has an annual electric energy requirement of about 75 billion kilowatthours and a peak load approaching 15 million kilowatts. About one-third of this area's electric energy supply in average years comes from hydroelectric sources. Gas and oil-fueled generation provides the bulk of the remainder with smaller amounts from nuclear and geothermal.

The drought, now in its second year, has reduced hydroelectric generation in the area to about 40 percent of its normal contribution. This, coupled with lengthy delays in the start-up of the over 2 million kilowatt Diablo Canyon project has caused an extremely

(more)

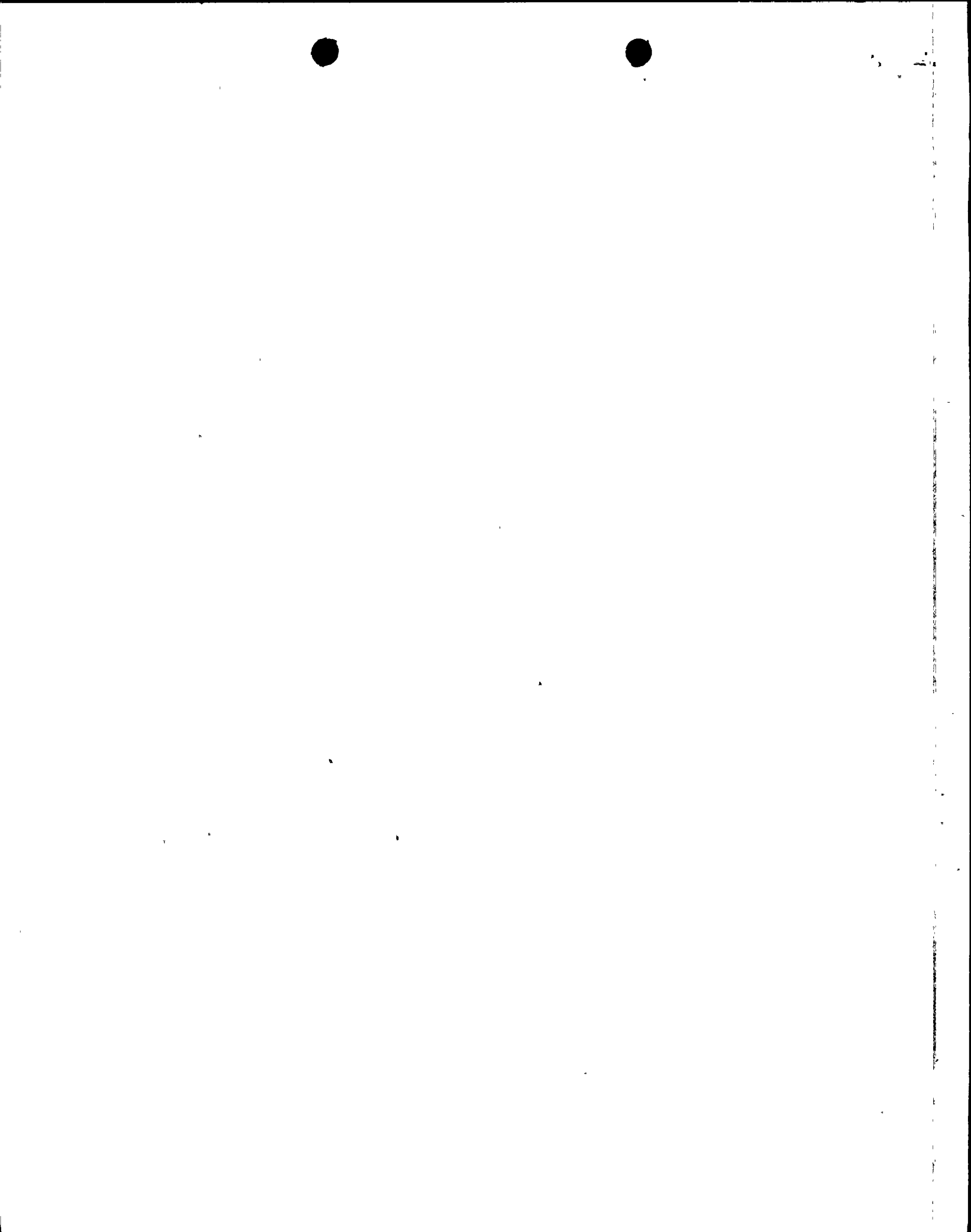


power supply situation. Only in the absence of major generating plant breakdowns is it anticipated that the public's electricity can be provided this year. Provision of these needs, however, requires large purchases of power from southern California and other utilities to make up for the power deficits in northern California. In addition, Californians are being asked to exert a conservation effort to help. If drought conditions and the unavailability of Diablo Canyon continue through the last part of 1977 and into 1978, the electric power deficit in northern California will be so large that there would be little possibility of obtaining the amounts needed from other utilities located outside the area. The shortfall in meeting the 1978 load would be nearly 10 billion kilowatthours and the capacity margin during the peak period would be totally inadequate, only about 3 percent.

A review of the power supply situation by our California Resources Conservation and Development Commission and our correspondence between them and the Nuclear Regulatory Commission this year has suggested the possibility of following an expedited licensing procedure to speed the needed regulatory decisions for Diablo Canyon. Consequently, at an appropriate time we plan to apply for an interim two-year full power operating license for

We would not be following this course, however, if we were not convinced that the plant is safe and that we can satisfy the people of that fact.

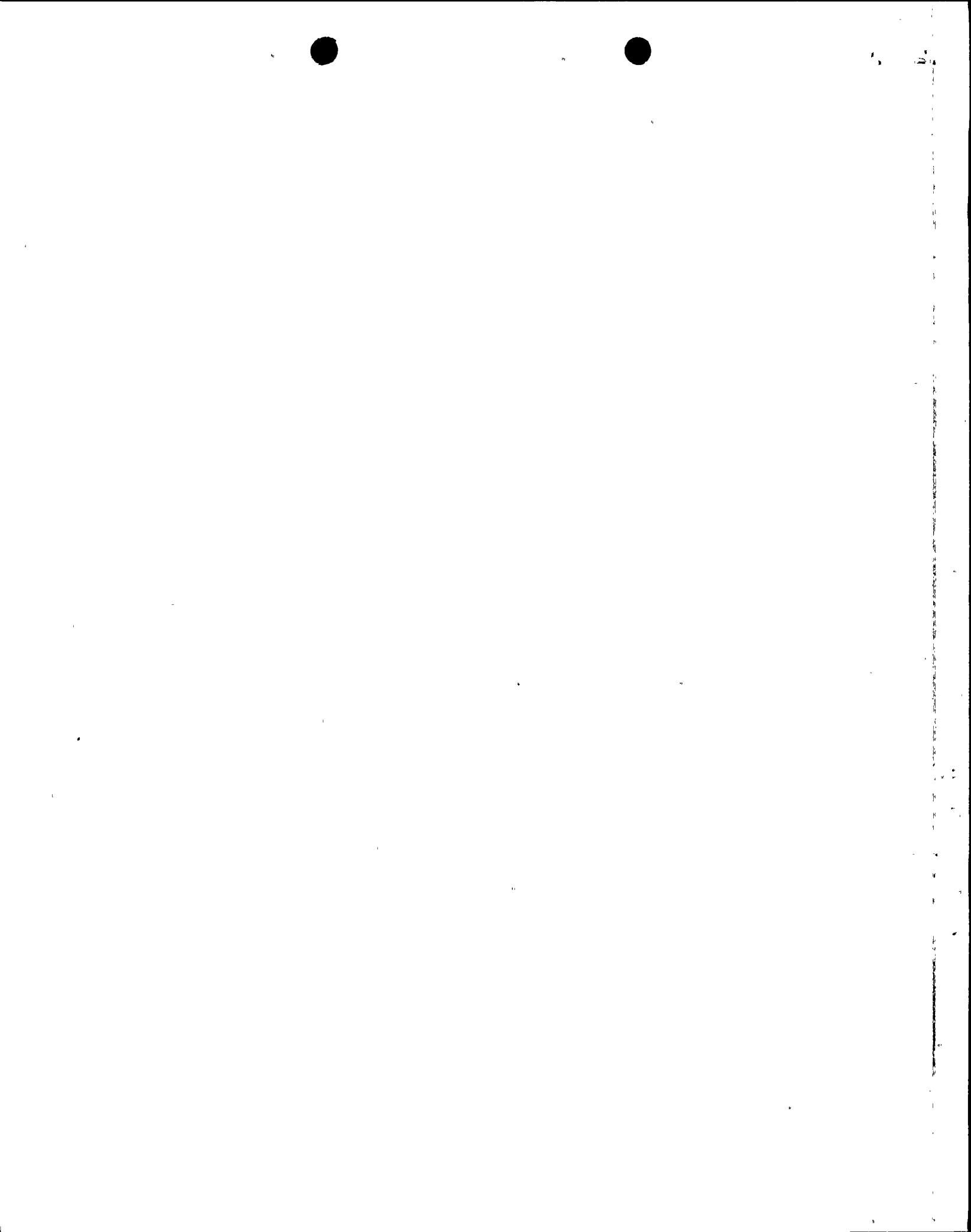
(more)



Let me turn now to the role played by seismic matters in our efforts to obtain operating licenses for the Diablo Canyon units. First I should mention that PGandE has been a pioneer in nuclear power development. Members of its engineering staff participated in industry feasibility studies dating back to the early 1950's. The Company was holder of AEC Operating License No. 1 for the small experimental Vallecitos generating unit.

Thus, when we were ready to begin detailed investigations of the suitability of the Diablo Canyon site in late 1965, the Company had an experienced engineering staff which we augmented by some of the most eminently qualified consultants available to provide independent assessments in their areas of expertise. The following consultants have been associated with the project for the past 12 years. In geology, our chief consultant has been Dr. Richard Jahns, Dean of the School of Earth Sciences at Stanford University. He performed reconnaissance investigations before we acquired rights to the Diablo Canyon site. In seismology the lead has been taken by Dr. Stewart Smith, now Chairman of the Department of Geophysics at the University of Washington. Seismic design aspects were addressed by Dr. John A. Blume, world-recognized authority in earthquake engineering. These consultants have been assisted by others: Dr. Jahns by Mr. Douglas Hamilton and his staff at Earth Sciences Associates; Dr. Smith by university colleagues through TERA corporation; and Dr. Blume by the substantial staff of his own consulting engineering firm.

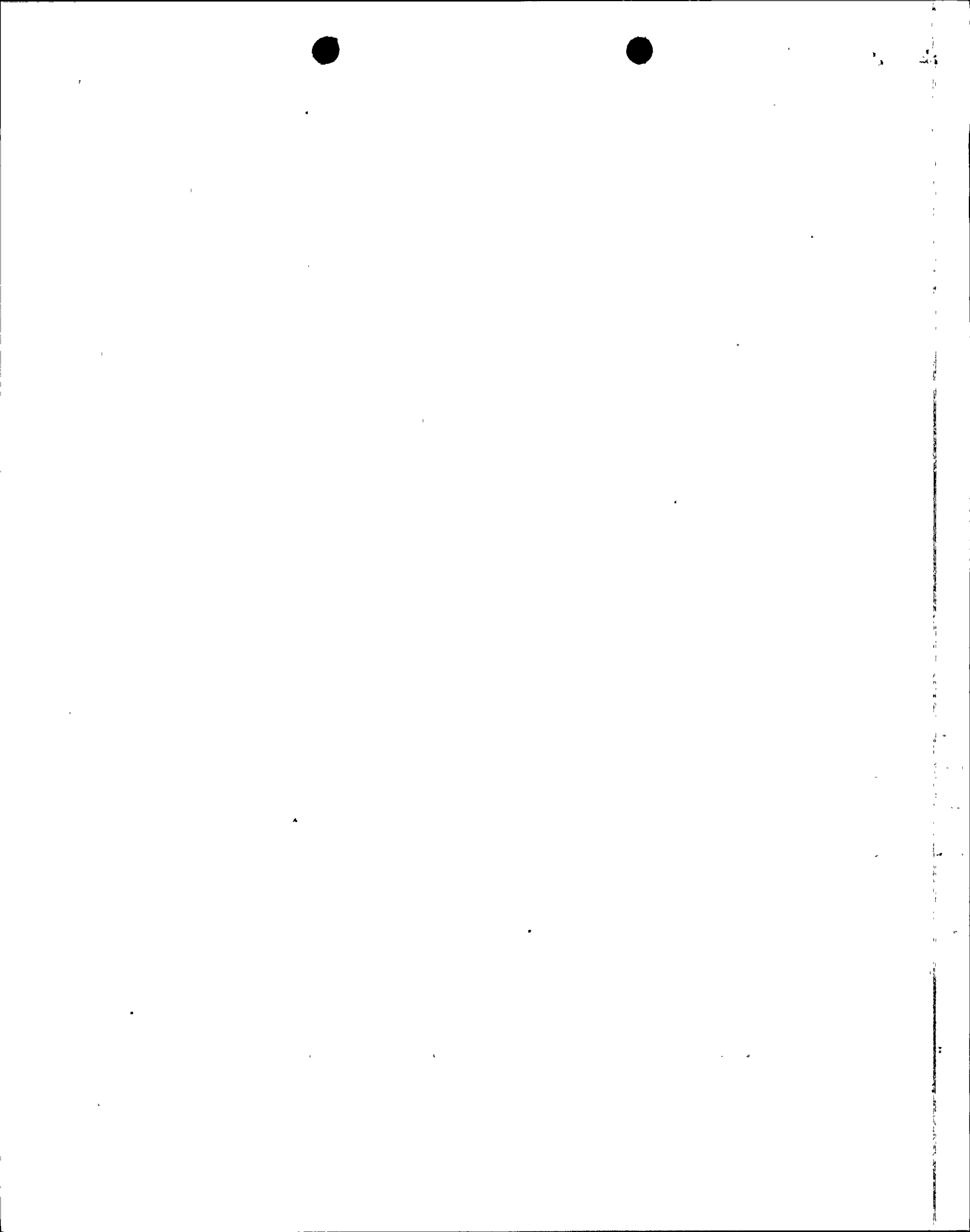
(more)



The investigations of the Diablo Canyon site, conducted 1965 and 1966, were without precedent in their extent and detail. Almost 2 miles of interconnecting exploration trenches, to 40 feet deep, were excavated through the area proposed for the reactor and related plant structures. The trenches permitted detailed examination of the bedrock structure, ancient wave-cut coastal terraces and overlying sedimentary deposits. This work demonstrated that the site had not been affected by significant tectonic movements. The geologic relationships present there showed that the probability of the site being affected by surface fault displacement was so remote that it could be disregarded in the design of the plant. Representatives of both the Atomic Energy Commission and of the U. S. Geological Survey inspected the site and the exploration trenches. They agreed that the exploration work confirmed the absence of any significant faulting on and near the site.

The 1966 investigations also established that the site is an area of relatively low seismicity, a conclusion which remains valid today. The regional geology, as evidenced on shore, was used to identify which faults could generate major earthquakes. Detailed geological analysis was facilitated by the exposed sea cliffs favorably located many miles up and down the coast from the site. The sea cliffs were closely examined and mapped in important sections. The consultants believed that this work, together with a knowledge of the major geologic trends throughout the region, allowed a reasonable evaluation of the off-shore area close to the plant site.

(more)



as reasoned that any nearby off-shore fault of major extent
 d have an on-shore extension or expression in the area to the
 h of the plant site. No such feature was found. Because of
 , the absence of seismic activity that would indicate a nearby
 ificant off-shore fault and the conservative assumption of a
 e earthquake anywhere in the region (including one directly
 r the site), offshore exploration did not seem necessary.

The major faults identified at that time by Dr. Smith
 governing the seismicity of the region were the San Andreas
 : 48 miles northeast, the Nacimiento Fault 20 miles northeast,
 the Santa Ynez Fault 50 miles to the south. This permitted
 ition of the most severe earthquakes that could occur in the
 on. He additionally postulated that such earthquakes would
 : at points on the faults nearest to the site. In addition to
 occurrence of very large earthquakes on these three faults,
 ance was made for the possible occurrence of a large earthquake (6.75M)
 to the site. This element of conservatism was necessary
 se the state-of-the-art in seismology did not permit a
 usion that the absence of surface faulting would preclude
 occurrence of a large earthquake.

From the information supplied by the seismologists and
 the nature of the rock at the site, Dr. Blume specified the
 characteristics of ground vibrations which could develop at the
 from the postulated earthquakes. He then established design
 :ia for the plant that would permit it to withstand the most
 : characteristics of these near and far eath^rquakes with a
 margin of safety. Thus a great earthquake on the San Andreas

(more)



Fault, similar to the 8+ magnitude 1906 San Francisco event and an assumed large earthquake on the Nacimiento Fault were considered together with the assumed large earthquake under the site. Further analysis showed however that the assumed large earthquakes on the Nacimiento Fault and under the site would cause the most severe shaking.

Dr. Blume also employed a conservative approach by not using the normally accepted concept of allowing overstress in materials and equipment for earthquake loads. With further conservatism, Dr. Blume's criteria specified that the design be checked against ground motions twice as severe as those calculated from these maximum postulated earthquakes. Both Dr. Smith's and Dr. Blume's detailed reports are in the files of the NRC and will be supplied if this Subcommittee so desires.

I have presented this background material in detail to make the following point: Conservatism was incorporated into the plant design that would cover contingencies of the very kind now being discussed.

The geologic and seismologic studies were reviewed by AEC, by USGS, and by the Coast and Geodetic Survey. In 1970, government scientists made use of their off-shore geophysical surveys in evaluating the Company's submittals. The seismic design criteria were approved with only minor modifications. The approved criteria were then incorporated into the construction permits for the two nuclear units -- issued in 1968 and 1970.

In late 1972 Mr. Hamilton learned of an article in Memoir #15 of the American Association of Petroleum Geologists, published in 1971, which indicated the presence of a fault (since named the Hosgriault) some 4-5 miles off-shore from Diablo Canyon. The article was



11-11-11

authored by Ernest G. Hoskins and John R. Griffiths, Shell Oil Company geologists. They reported on off-shore surveys done in connection with oil exploration performed by Shell during the 1950's-1960's along the central and northern California coast. The work was a survey of conditions at considerable depth beneath the ocean floor to study large off-shore basins. Mr. Hamilton called attention to the paper and its map.

Given the information developed in our earlier geologic and seismologic investigations, these features did not appear significant in terms of the design criteria for the plant. Nevertheless, investigation continued.

In February, 1973, Mr. Hamilton was able to contact Hoskins and discuss the Shell surveys. A month or so later, at PGandE's request, Mr. Hamilton visited the Shell office in Los Angeles and reviewed some of the data used in the paper. These data suggested that the faulting described by Hoskins and Griffiths was relatively old. Since the seismic record of the area also indicated, at most, a low level of seismic activity, the allowances in the design for an assumed large earthquake beneath the site were judged to be fully capable of accounting for any events associated with this new feature.

However, the Hoskins and Griffiths work was additional important geologic information and when PGandE's FSAR was submitted to the AEC during the summer of 1973, it included a description of the off-shore fault mapped by Hoskins and Griffiths, including the locations of minor seismic activity possibly associated with it.



Faint vertical text or markings along the right edge of the page, possibly bleed-through from the reverse side.

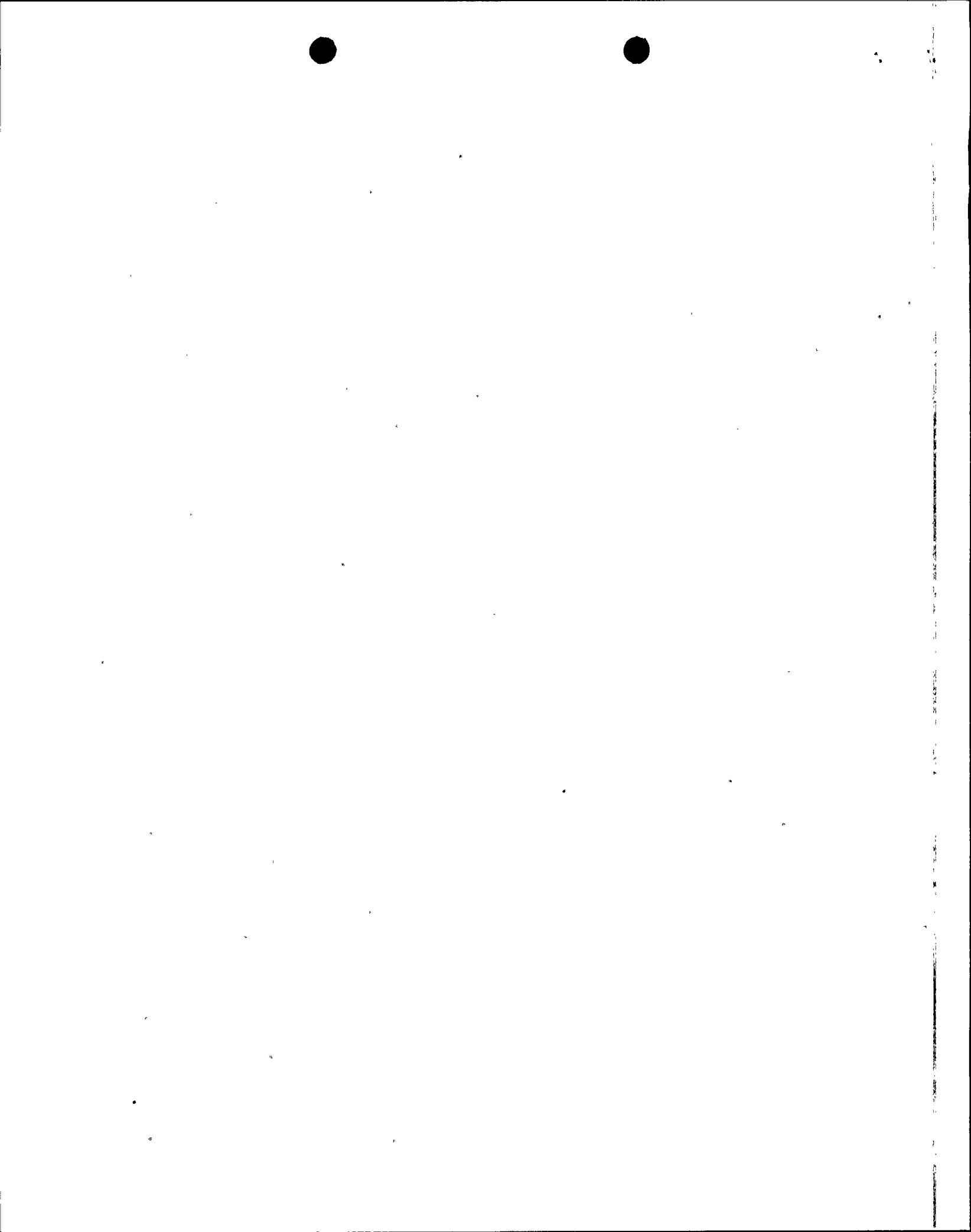
During the AEC's review of the FSAR they requested further information about the faults that had been mapped by Hoskins and Griffiths.

PGandE then determined that the USGS, in connection with an ongoing program of coastal research funded by the AEC, was planning on conducting survey work specifically directed to the central California coastal region, including the Diablo Canyon vicinity. This work was in fact performed by the survey ship Kelez in October-November, 1973.

PGandE learned in mid-November, through the media, that the USGS work supposedly disclosed indications of surface faulting of the sea floor. After consultation with the USGS, we commissioned our own survey to supplement their information and to clear up possible confusion over the nature of the sea floor scarp identified in the press as a "surface fault." Our findings and those of USGS were reviewed at a meeting with the AEC staff in January, 1974, specifically in relation to three local faults mapped by the USGS. In its report of that meeting, the staff concluded that one of these faults might be related to the larger structure mapped by Hoskins and Griffiths; however, they felt that any ground motions produced at the site by an earthquake on any of these faults would be well within the limits for which the plant was designed.

In April, and again in November, 1974, the Atomic Safety Licensing Board denied some intervenors' requests that work on the plant be stopped.

(more)



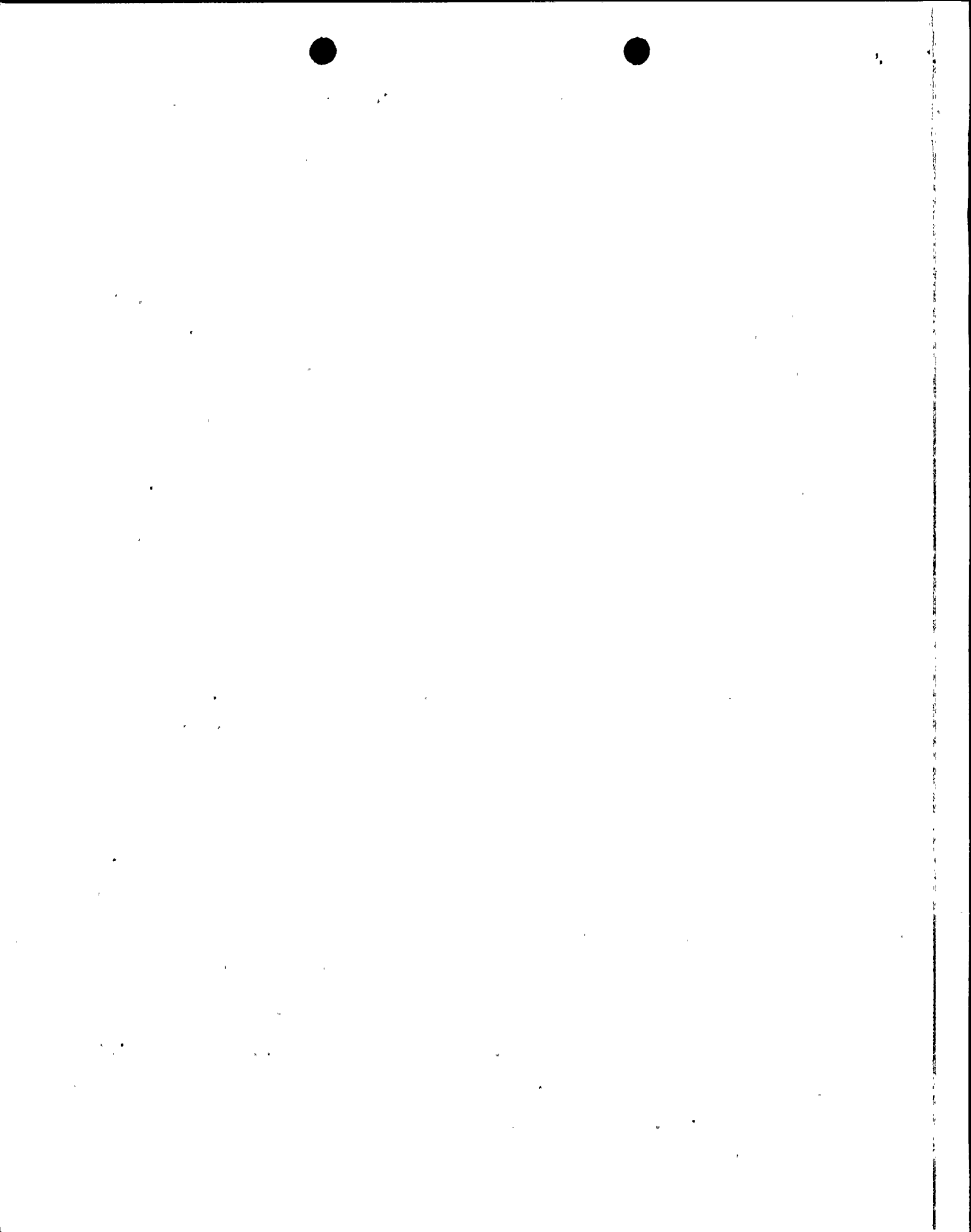
The Company, reinforced by the exhaustive studies and opinions of its consultants, remains convinced that the Hosgri Fault cannot reasonably be expected to generate earthquakes that will exceed the strength already built into the Diablo plant.

In December, 1974, after we had responded to AEC questions about the Hosgri Fault, the AEC took the position that the Hosgri Fault could affect the seismic design basis of the plant. It requested that the plant be checked for a site ground motion somewhat greater than that specified by us in the original design.

Then, in January, 1975, the USGS evaluation of the Hosgri Fault was forwarded to NRC. The evaluation took the position that the new ground motion level used by the NRC was still inadequate. This contention was apparently based in part on a university senior report sponsored by USGS. This study, by student William Gawthrop, raised the possibility that the origin of the 1927, 7.3M Lompoc earthquake could be reassigned to the southern end of the Hosgri structure rather than to a fault further off-shore. The Gawthrop paper was open-filed in May, 1975. After extensive review and analysis, the Company's consultants determined that Mr. Gawthrop's contention cannot be supported by either the seismological or geological data. They instead assign the Lompoc earthquake to a fault referred to as the "offshore Lompoc fault" located southwest of the Hosgri fault.

The NRC requested additional information about the 1927 earthquake and other matters in light of the USGS evaluation of January, 1975. This information was developed using further off-shore data which had subsequently been open-filed by the USGS and

(more)



proprietary data which was purchased, together with additional seismological studies by Dr. Smith.

In December of 1975 Dr. Clarence Hall published a paper which suggested extensive movement along the Hosgri Fault. Our consultants reviewed this paper and did additional field work to check some of the evidence cited. They were then able to conclude that this postulation of large movement was precluded by other evidence. In April, 1976, after we had submitted to NRC considerable additional information and had participated in numerous discussions with its staff, a further USGS evaluation was given to NRC. In this evaluation, USGS repeated its position as set forth in January, 1975, but this time recommended a specific design basis earthquake. The ground motion at the site from this postulated earthquake was substantially more severe than the already higher values studied in December, 1974, at the AEC's request. The NRC accepted this April, 1976, assessment and asked us to provide an appropriate evaluation of the plant. PGandE and its consultants believe that the earthquake parameters selected by USGS and the resulting ground motion values are unreasonably high.

Nevertheless, in an effort to get this vitally necessary plant licensed without further delay, we have undertaken the requested analysis. The seismic criteria for the evaluation were prescribed by the NRC staff in May, 1976. These criteria were the subject of several meetings by the subcommittee of the ACRS and the ACRS itself.

In December, 1976, the ACRS, by letter, requested the NRC staff and the Company to respond to the comments of their consultants with respect to the criteria being used for evaluation.

(more)



1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

Early this month we filed with the NRC a four-volume partial report on the evaluation and response to the comments of the ACRS consultants. We presented ^{this} their material to the ACRS subcommittee in a three-day meeting last week. We had hoped the subcommittee might take the necessary action for the matter to move to the full committee by its August or September meeting. However, the ACRS will not act until it reviews a report of the NRC staff which will be completed following a filing of additional studies requested of the Company. We now believe that an ACRS meeting on seismic issues can be scheduled this fall and that further licensing procedures can go forward expeditiously.

We estimate that Unit No. 1 could be made critical within 45 days after receiving permission to load fuel. In another 30 days it could reach full power.

The analysis of the plant for the latest postulated earthquake shows that modifications required will be relatively minor. Such modifications could readily be made even after the plant has started to operate.

Let me summarize:

(1) We have accepted the extreme and in our opinion excessive USGS criteria for review of our design and are now hard at work finishing this review.

(2) The Company firmly believes that the units at Diablo Canyon have been designed and constructed with great care and conservatism, and are of more than adequate strength to withstand the effects of earthquakes that might occur from the Hosgri or other faults.

(more)



1

1

1

(3) In order to get past the regulatory delays, however, we have agreed to make modifications required by the more extreme criteria, with which we do not agree.

(4) Starting the unit up on an interim basis will not result in unreasonable risks to the public health and safety. Such startup will only be permitted after required safety findings have been made by the ACRS and NRC.

(5) The plant and its seismic evaluation have been reviewed at enormous length. The site and the plant have received the most exhaustive examination and seismic analysis ever carried out. The experts of the world have been involved and their work is open for examination. The scope of this evaluation is indicated by the following:

(a) Since the Operating License was docketed in October of 1973 there have been 50 additional submittals, 17 of which were related to geology, seismology, and seismic design.

(b) Out of 42 meetings with the NRC regulatory staff, 24 were concerned primarily with geology, seismology, and seismic design.

(c) There have been 7 meetings with the ACRS subcommittee and 3 with the full committee. Additional meetings have been scheduled to continue the review and to exhaust the seemingly endless questioning.

(d) The intervenors have had full access to the hearings and have taken every advantage of their opportunities. The public has been heard and will be heard further in the forthcoming regulatory hearings.

(e) The process has already taken many years. The



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

important point is that here is a safe plant ready to operate and supply the needs of millions of consumers in a period of shortage. It is unreasonable to delay operation longer.

(f) We believe that the interest of the public would be well served by expediting the remaining exhaustively searching regulatory process.

Thank you for this opportunity to appear.

###



RESPONSE CPUC INQUIRY OF MARCH 8 1977
RE DIABLO CANYON DATA REQUESTS

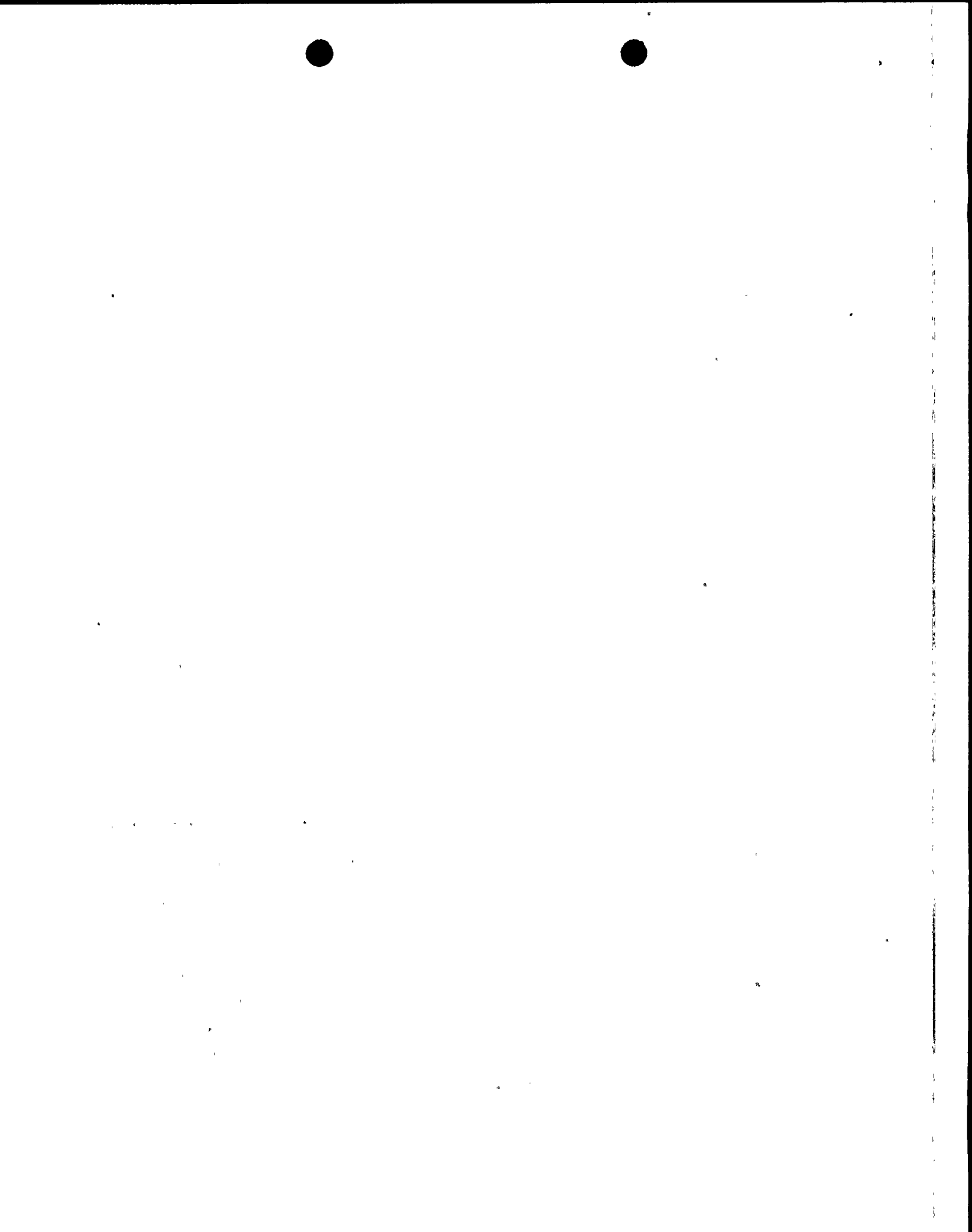
1. Request

What alternate site locations were considered as alternatives to the Diablo Canyon Site?

Response

Diablo Canyon was selected after an extensive survey of alternatives. Initially, three sites, located on PGandE owned property at Nipomo, Collinsville and South Moss Landing, were considered sufficient for the Company's future nuclear power plants. Other sites in the central coastal area which were considered were described and evaluated for the CPUC at the time of the hearings on A-49051 (Unit 1). Excerpts from Exhibit No. 19 submitted at these hearings are attached as Exhibit "A". The sites considered at that time were the following:

1. Point Sierra Nevada (San Luis Obispo County)
2. Cambria (San Luis Obispo County)
3. Cayucos (San Luis Obispo County)
4. Cuesta (San Luis Obispo County)
5. Point Buchon (San Luis Obispo County)
6. Diablo Canyon (San Luis Obispo County)
7. Avila Beach (San Luis Obispo County)
8. Nipomo (San Luis Obispo County)
9. Point Sal (Santa Barbara County)
10. Surf (Santa Barbara County)



11. Jalama (Santa Barbara County)

2. Request

Discuss the site locations. What site did PGandE favor? Why was Diablo Canyon site selected? Why were the alternate site locations rejected?

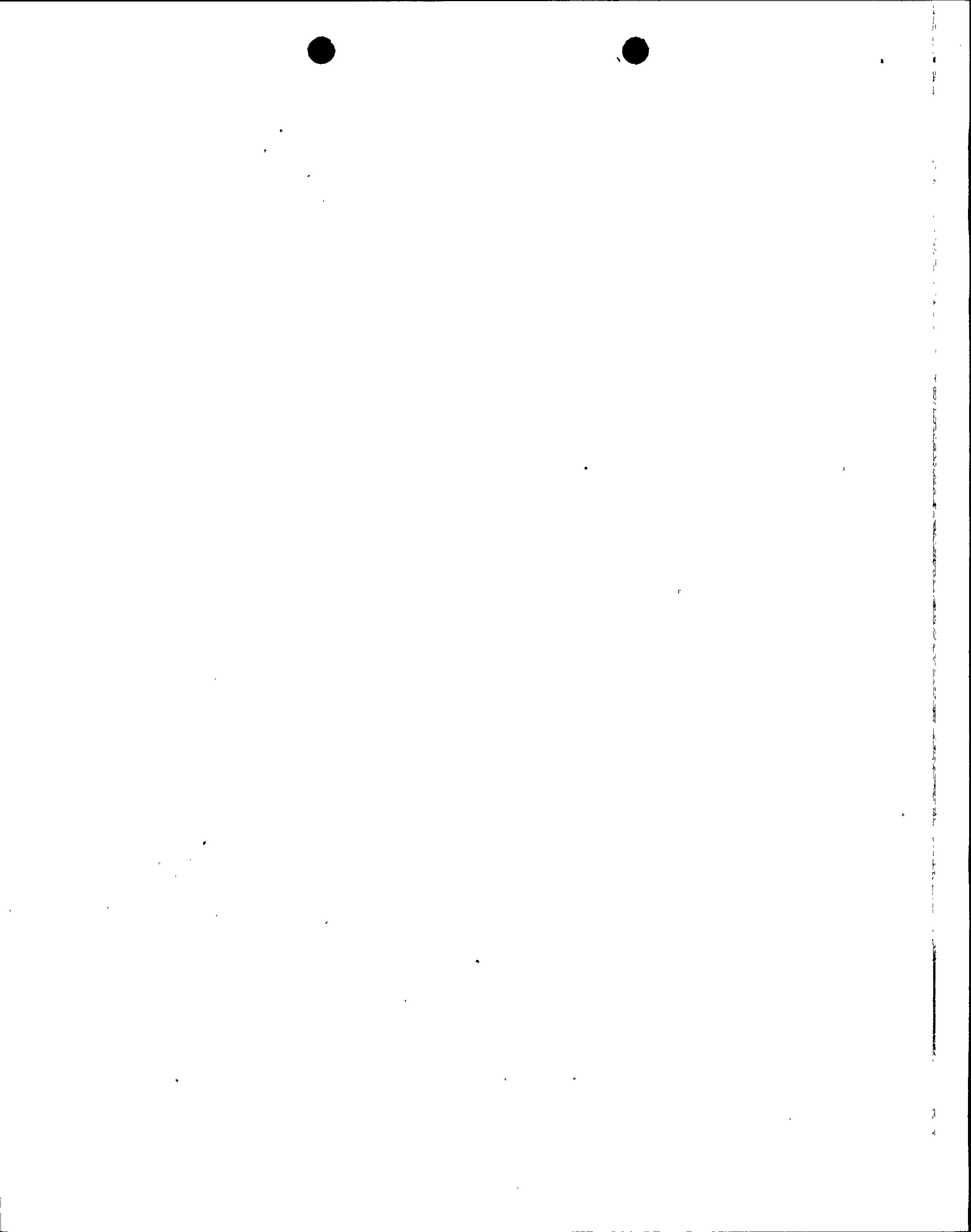
Response

Exhibit "A" (excerpted from Exhibit No. 19, A-49051) contains a map which shows the locations of sites considered. In the selection process, PGandE took numerous factors into account, these factors were listed in a summary comparison also contained in Exhibit "A".

The Nipomo site, already owned by PGandE was initially favored by the Company, but the Nipomo Dunes were an area of very significant environmental concern and the position taken by the State Resources Agency and concerned conservation groups that the plant would have to be set back some 5,000 feet from the shore, made it much less attractive. For this reason, Diablo Canyon site was eventually selected. To summarize the primary reasons for the selection of Diablo Canyon were:

a) Physical Features - sound rock foundation, relatively low seismicity, a geologic investigation facilitated by numerous surface exposures. Detailed information on the physical factors is contained in various reports which were submitted to the Commission, attached as Exhibits "B-D".

b). Minimal environmental impact, coupled with favorable responses from the State Resources Agency, conservation groups, county and local organizations.



c) Favorable cost comparison with Nipomo Site (once the set back requirement was considered). See Exhibit "H".

Nipomo and Diablo Canyon were the primary choices; others mentioned were much less attractive, particularly with respect to land acquisition and community acceptance problems.

3(a) Request

What preliminary seismic studies were conducted prior to the filing of the Diablo Canyon certificate application?

Response

The Diablo Canyon Unit No. 1 Certificate Application (A-49051) was filed on December 23, 1966. The seismic and geologic studies which were conducted prior to the filing are described in the following reports which were entered in evidence during hearings held by the Commission in February of 1967.

1. "Diablo Canyon Nuclear Plant Site Preliminary Geologic Investigation" Report No. 5326-65, issued January 25, 1966, by M. Micheli, Geologist.
2. Letter report, dated December 8, 1966, of E. C. Marliave, Consulting Geologist.
3. "Geology of the Diablo Canyon Power Plant Site," by Richard H. Jahns, Geologist, and "Geology of the Diablo Canyon Power Plant Site." Supplementary Report by Richard H. Jahns, Geologist.
4. "Seismic Evaluation of the Diablo Canyon Site," by Hugo Benioff and Stewart W. Smith.
5. "Earthquake Design Criteria for the Nuclear Power Plant -- Diablo Canyon Site" by John A. Blume



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

and Edward J. Keith.

6. "An Evaluation of Tsunami Potential at the Diablo Canyon Site" December 1966 by Paul L. Horrer and Noel B. Plutchak.

These reports are included here as Exhibits "B-G".

3(b) Request

What was the scope of these preliminary studies and what conclusions were reached?

Response

Seismic and geologic investigations for the Diablo Canyon site commenced in late 1965. These studies began after a company site selection process (see Item Nos. 1 and 2) identified Diablo Canyon as a potential site. These studies, by Company personnel and private consultants, entailed a detailed look at site and regional seismic-geologic conditions affecting the site's viability. In making this determination, extensive seismic-geologic investigations were conducted for the Diablo Canyon site in 1965 and 1966.

Geologic mapping of the site area was conducted by a company geologist in 1965 (Exhibit "B") and then again by the independent geologic consultants (Exhibit "C" and "D"). To document the site's geologic suitability and the geologists' preliminary conclusions, exploratory trenching operations were conducted twice in the site area. The first trenches were open in September 1965. The second, more extensive, trenching operation took place in September and October 1966. These latter trenches were excavated through the proposed area for the reactor and



related plant structures. The trenches permitted detailed examination and documentation (geologic mapping and photographs) of the bedrock structure, ancient wave-cut coastal terraces and the overlying sedimentary deposits. This work demonstrated that the proposed site had not been affected by significant fault movements.

Representatives of both the AEC and the U.S. Geological Survey inspected the site and exploratory trenches and agreed with these conclusions.

The 1966 investigations also established that the site is in an area of relatively low seismicity, a conclusion which remains valid today. The regional geology, as evidenced on-shore, was used to identify which faults could generate major earthquakes. Detailed geological analysis was facilitated by the exposed sea cliffs favorably located many miles up and down the coast from the site. The sea cliffs were closely examined and mapped in important sections. PGandE's consultants believed that this work, together with a knowledge of the major geologic trends throughout the region, allowed a reasonable evaluation of the off-shore area close to the plant site.

It was reasoned that any nearby off-shore fault of major extent would have an on-shore extension or expression in the area to the south of the plant site. Because of the cliff-face exposures, the existence of such shoreward fault extensions could be established with a high degree of accuracy. No such features were found. A known fault with seaward extension, the Santa Ynez fault, was located some 50 miles south of the plant



and was used in the seismic analysis described below.

Further supportive data suggesting the absence of nearby active off-shore faulting was supplied by the seismological consultants retained by the Company. These consultants in their seismic evaluation of the Diablo Canyon site (Exhibit "E") reported on the low historical seismicity near the site.

The major faults identified at that time by the seismologists as governing the seismicity of the region were the San Andreas Fault 48 miles northeast, the Nacimiento Fault 20 miles northeast, and the Santa Ynez Fault 50 miles to the south. This identification permitted definition of the most severe earthquakes that could occur in the region. The seismological consultants also postulated that such earthquakes would occur at points on the faults nearest to the site. In addition to the occurrence of very large earthquakes on these three known faults, allowance was made for the postulated occurrence of a large earthquake (6.75M) under the site. This conservative assumption was made to accommodate an after-shock from a major event occurring on one of the described faults; it would also incidentally accommodate motion from possible undescribed faults.

The information and conclusions supplied by the geologists and seismologists was input into determining the project's seismic design (Exhibit "F"). This information was used again during the evaluation of the tsunami potential at the Diablo Canyon site. (Exhibit "G").

These independent consultants provided not only their analysis of the site conditions, but they were responsible for



.

.

.....

defining the scope of the investigations necessary to document any conclusions made. This independent evaluation of the Diablo Canyon site by eminently qualified consultants was believed to be the best possible documentation of the Diablo Canyon site's geologic-seismic suitability.

The geological and seismic investigations resulted in the conclusion that the Diablo Canyon site was geologically and seismically suitable. Conservative design criteria were established based on these data.

3(c) Request

Name the consultants that were considered for conducting preliminary site studies and furnish copies of the proposed contractual basis for each consultant as well as all related correspondence.

Response

The consultants who were considered for conducting preliminary site studies were grouped into the following areas:

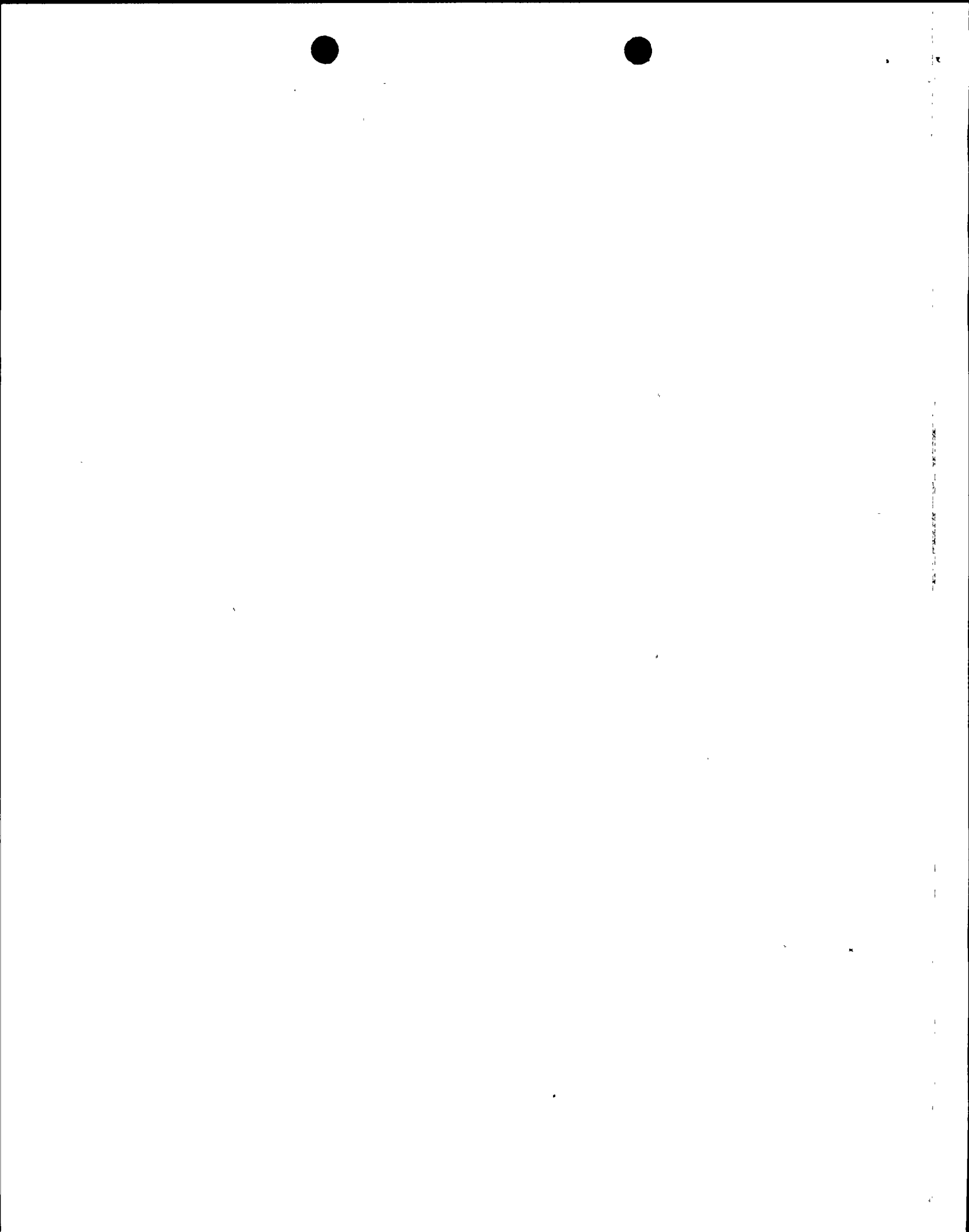
Geology

Seismology

Seismic Design

Tsunami

No contract was made with any of the proposed consultants prior to their being retained. Precontract discussions centered on the consultants' professional qualifications and availability. During these preliminary discussions the proposed work was outlined and the consultants' professional fees were identified. The proposed contract arrangement with all the consultants was a



daily fee plus expenses. The actual contractual basis with those consultants who were eventually retained is discussed in the response to Item No. 3(g).

The consultants who were considered for conducting preliminary studies included:

Geology

E. C. Marliave
Frank A. Nickell
Richard H. Jahns
Thomas Thompson
Roger Rhodes

Seismology

Hugo Benioff
Bruce Bolt
Clarence Allen
Robert Korach
Stewart Smith

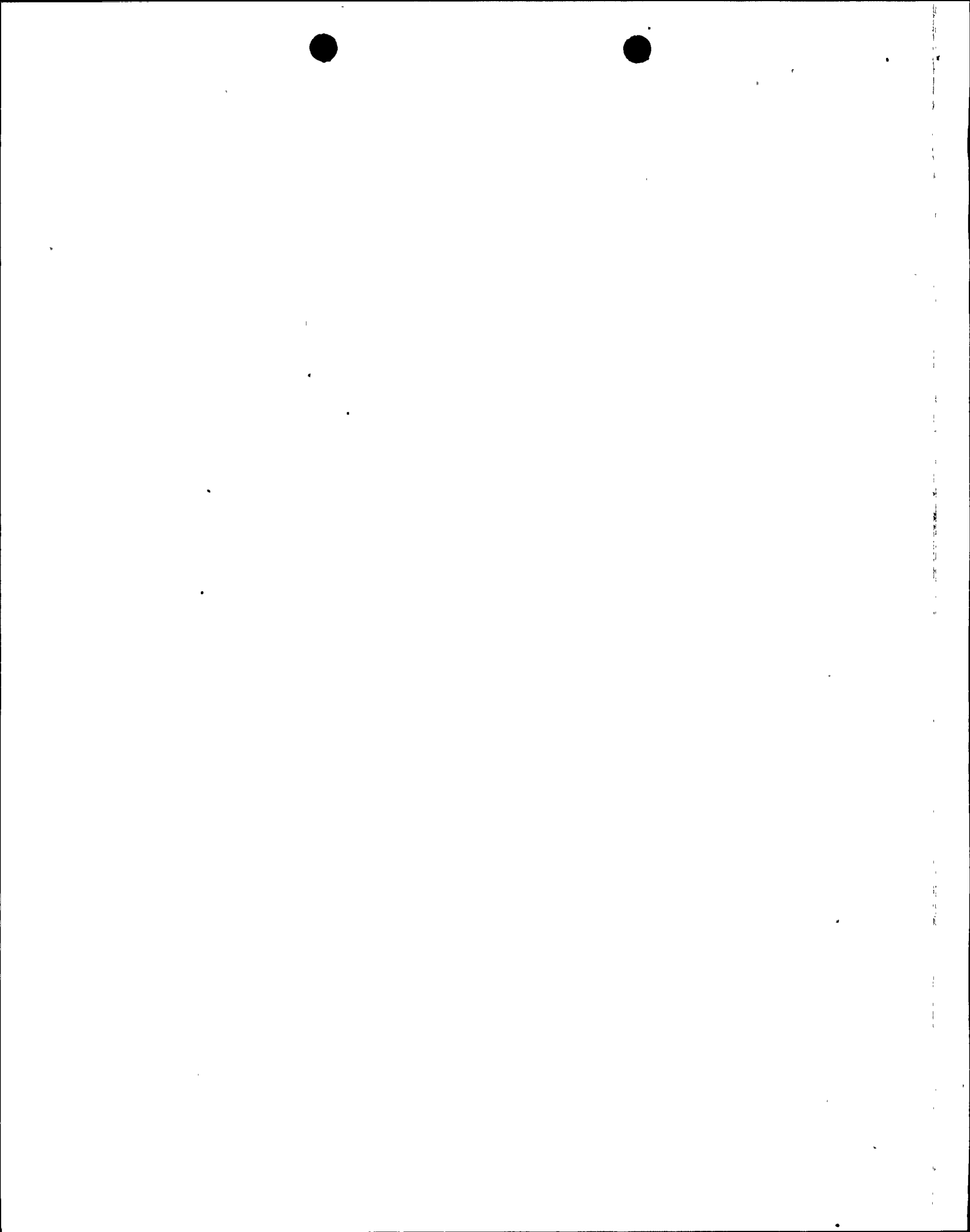
Seismic Design

George Housner
John A. Blume and Associates
Ray Cluff
N. M. Newmark

Tsunami

Marine Advisers

Correspondence with the proposed consultants related to the proposed contractual basis is included in the response to Item No. 3(g), Exhibit "I".



3(d) Request

Name the consultants, seismic and geologic, who conducted the preliminary studies.* Also, give a summary of the consultants' education and professional experience.

Response

The following consultants were retained to conduct studies on the Diablo Canyon site.

Geology

E. C. Marliave

R. H. Jahns

Seismology

H. Benioff

S. Smith

Seismic Design

J. A. Blume and Associates

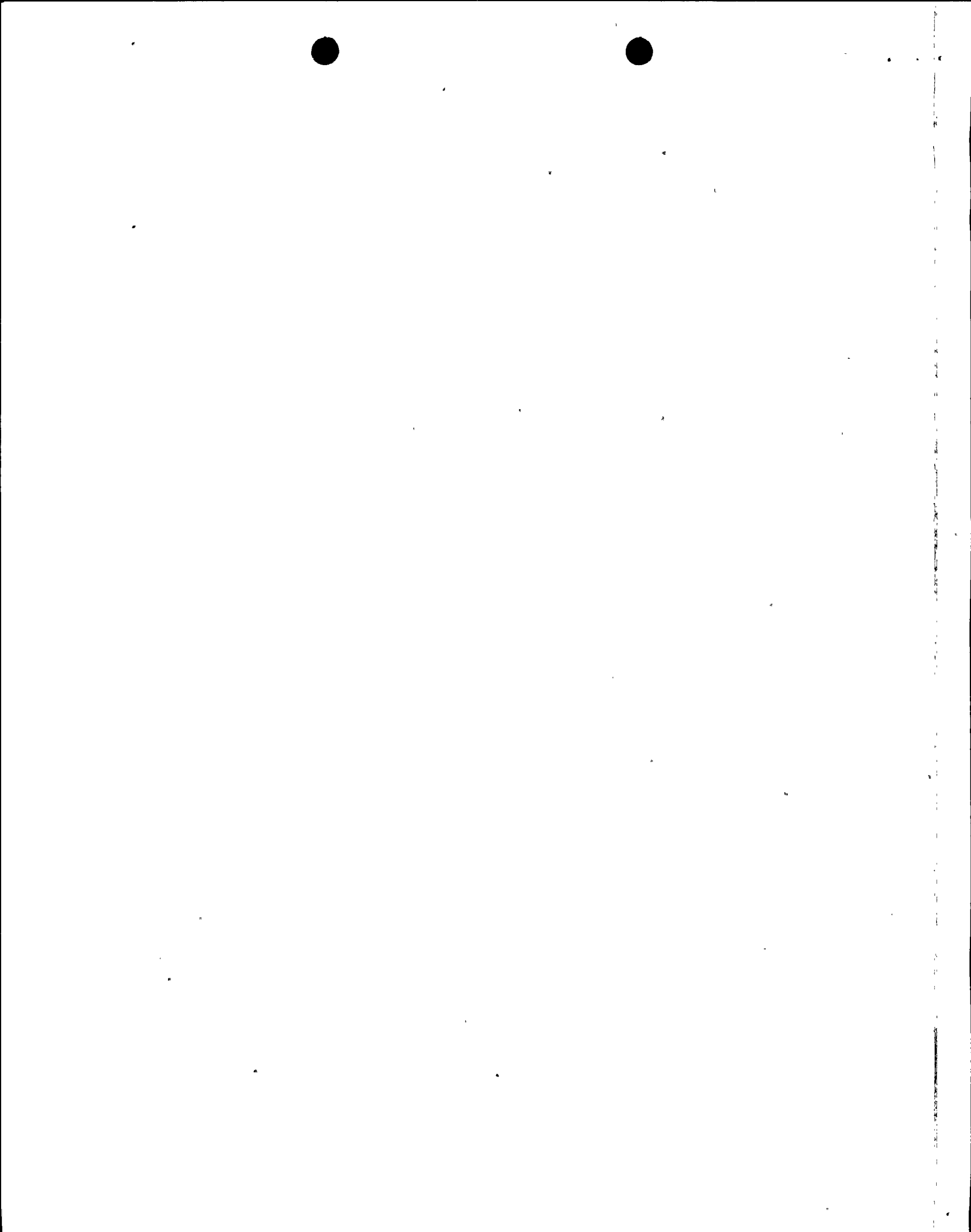
Key Personnel: J. A. Blume and E. J. Keith

Tsunami

Marine Advisers

Key Personnel: P. L. Horrер and N. B. Plutchak

* Where a question used "preliminary" PGandE, in the interest of time and completeness has responded with answers going well beyond work that could be described as merely "preliminary" but has held to a time sequence roughly preceding the filing of and hearings on the Certificate for Unit #1. D. H. Hamilton of Earth Sciences Associates was retained to assist Dr. Jahns in 1972 and has performed a great deal of important work. His individual biography is included for convenience. There were others in the later period also, their names and background can be listed if desired. We have attempted to include correspondence with all consultants in response to questions asking for such correspondence.



The qualifications of these consultants, including their education and past experiences, are attached in the form of individual biographies (Exhibit "J"). Also included in Exhibit "J" is a biography for M. Micheli, a Company geologist, who participated in the geologic investigation of the Diablo Canyon site.

3(e) Request

Furnish a copy of the study results.

Response

The study results were in the reports listed in the response to Item No. 3(a), which are included as Exhibits "B-G".

3(f) Request

On what basis were the consultants in (d) retained?

Response

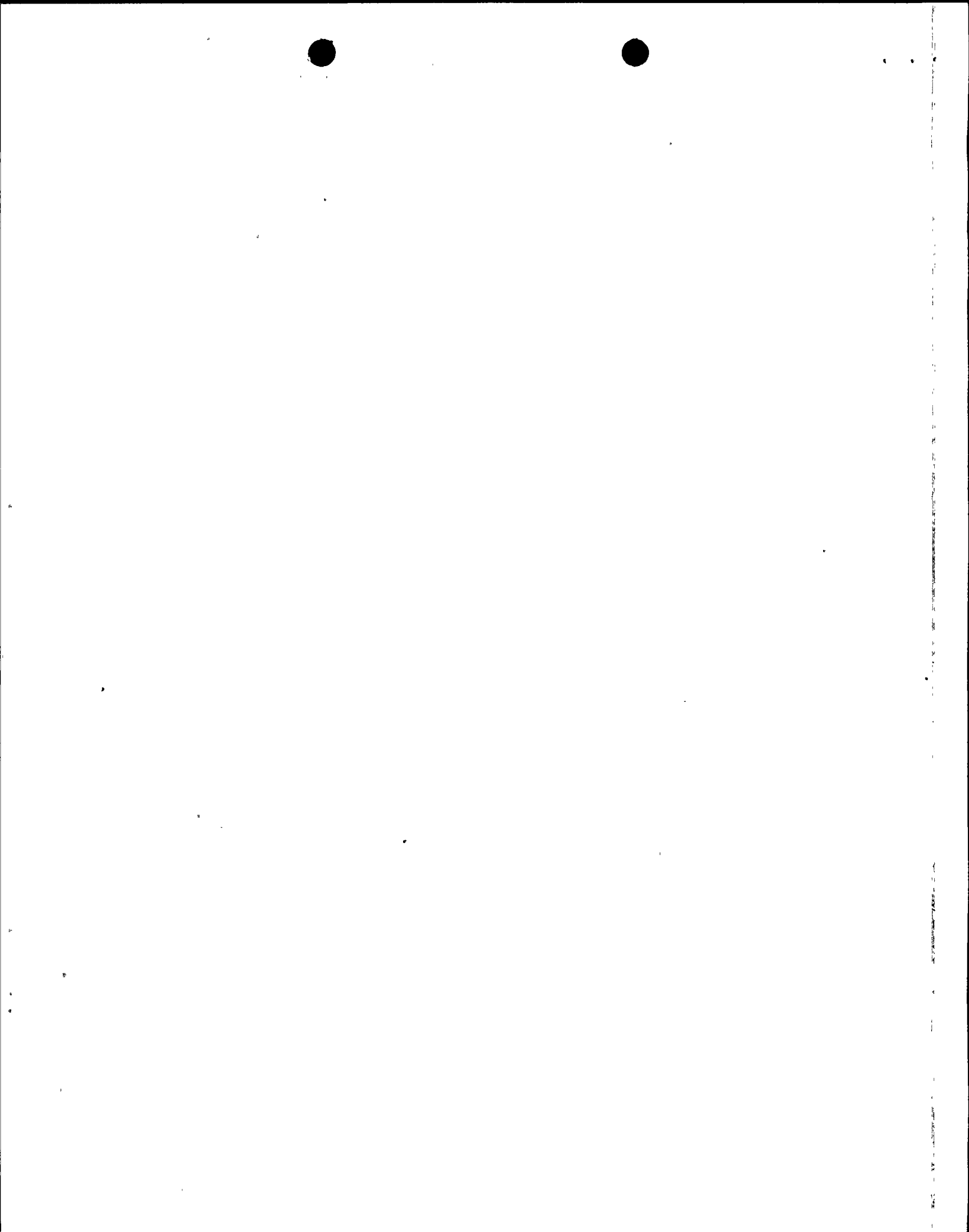
The consultants who were retained, were hired on the basis of their professional qualifications and availability to perform the preliminary investigations on the Diablo Canyon site. The professional qualifications of these consultants are detailed in the response to Item No. 3(d). The contractual basis with each of the consultants is discussed in the response to Item Nos. 3(c) and 3(g).

3(g) Request

Furnish a copy of the contract with the consultants in (d) as well as all subsequent correspondence to the current date.

Response

No formal contracts were drawn up for the professional



consultants listed in the response to Item No. 3(d).* These consultants were retained on a daily fee plus expenses basis. The scope of work to be performed by each consultant was discussed with and authorized by Company management prior to its undertaking. Part of the preliminary negotiations was an agreement on the fee schedule to be used by each consultant. The consultant's commitment was to provide the agreed upon professional services and to document their services rendered and expenses incurred.

Documents relating to contractual matters are included in Exhibit "I" along with the correspondence with the consultants up through early 1977.**

4. Request

What offshore surveys were conducted by PGandE and/or its seismic consultants for each site before licenses or certificates were granted?

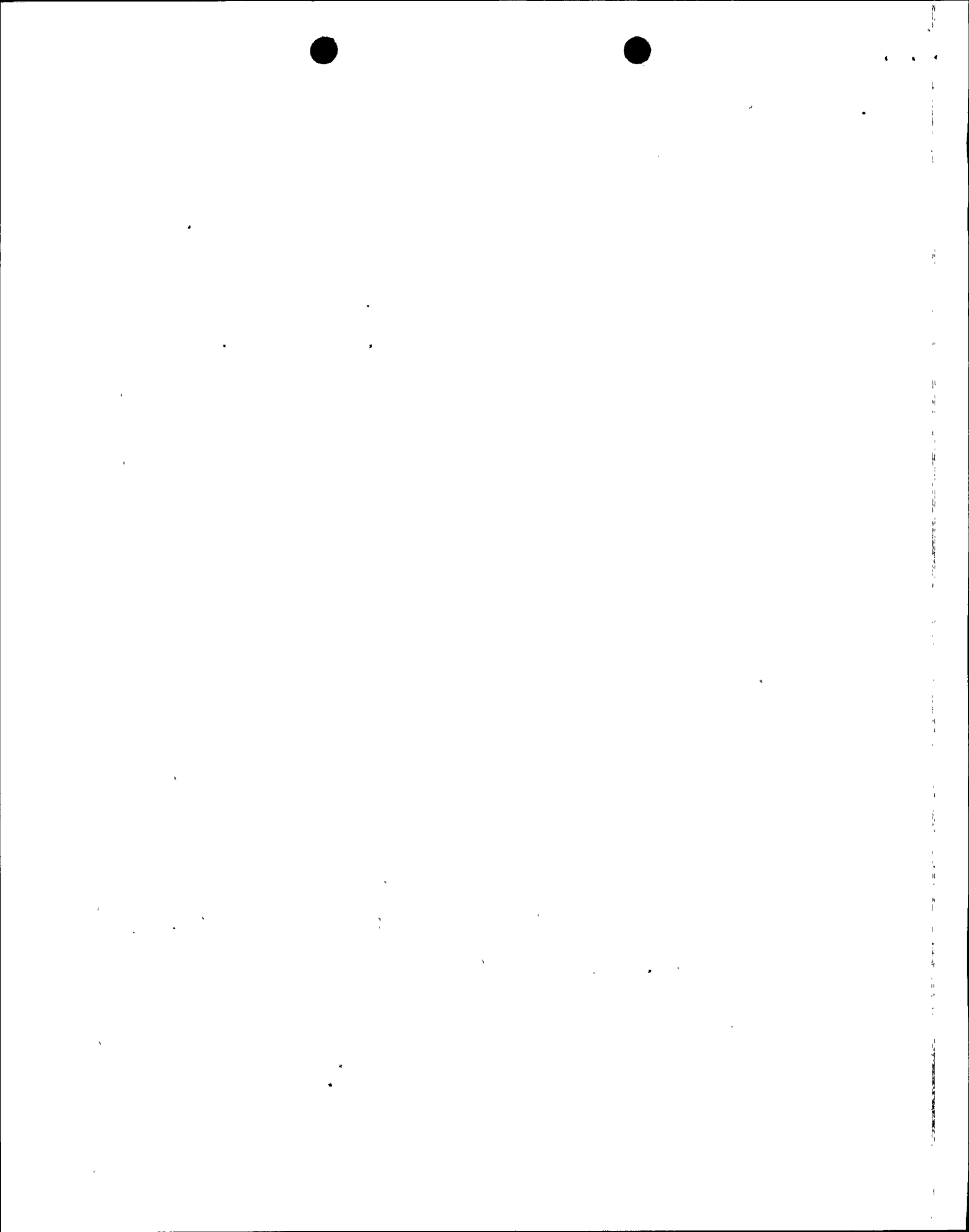
(a) If offshore surveys were conducted, please furnish a copy of the results of the study.

Response

Some underwater work was performed in the immediate vicinity of the site with respect to harbor evaluation and the siting of intake and breakwater structures. However, neither PGandE nor its consultants carried out any offshore marine survey

* Some later work was done under written contract.

** Correspondence with respect to the breakwater, in the interests of space, has not been included.



work prior to certification.

4(b) Request

If offshore surveys were not conducted, please explain why this position was taken.

Response

A response to this request is contained in Response 3(b) in the overall context of the geologic and seismic studies conducted at the time. Briefly, marine survey work did not seem necessary because of:

1. the absence of either (a) any onshore expression south of the plant or (b) recent seismic activity, either of which would indicate a nearby significant offshore fault*, and
2. the conservative assumptions made with respect to large earthquakes (including the postulated shock directly under the site).

4(c), (d) and (e) Requests

(c) Was PGandE and/or your seismic consultants aware of the Hosgri Fault at the time it was discovered or when the

* The reasoning was apparently confirmed during this period by the fact that the U. S. Coast and Geodetic Survey, probably the most experienced marine survey organization in the world, which was acting as advisor to the A.E.C. made no suggestion that marine survey work should be performed. As of 1970 the U.S.G.S. reported the use of "marine geophysicists" and offshore "geological structural information", to support the conclusion that offshore trends were NW-SE (as concluded by PGandE's consultants) and to dispose of suggestions that they recently reported earthquake epicenters trended toward Diablo Canyon.

discovery data was published in 1971?

(d) If information on the Hosgri Fault was available to PG&E and/or its seismic consultants, what evaluation was made at the time of the initial awareness of the fault?

(e) Furnish the basis for the course of action taken at that time. Provide copies of all correspondence, including memoranda between PG&E, its consultants, governmental bodies, and professional parties, as well as internal memoranda on this matter up to that point in time.

Response

PG&E and its seismic consultants were not aware of the Hoskins-Griffiths work prior to its publication in 1971. Subsequent evaluations, after the Company became aware of the Hoskins-Griffiths paper in late 1972, are summarized in the response to Request 9.

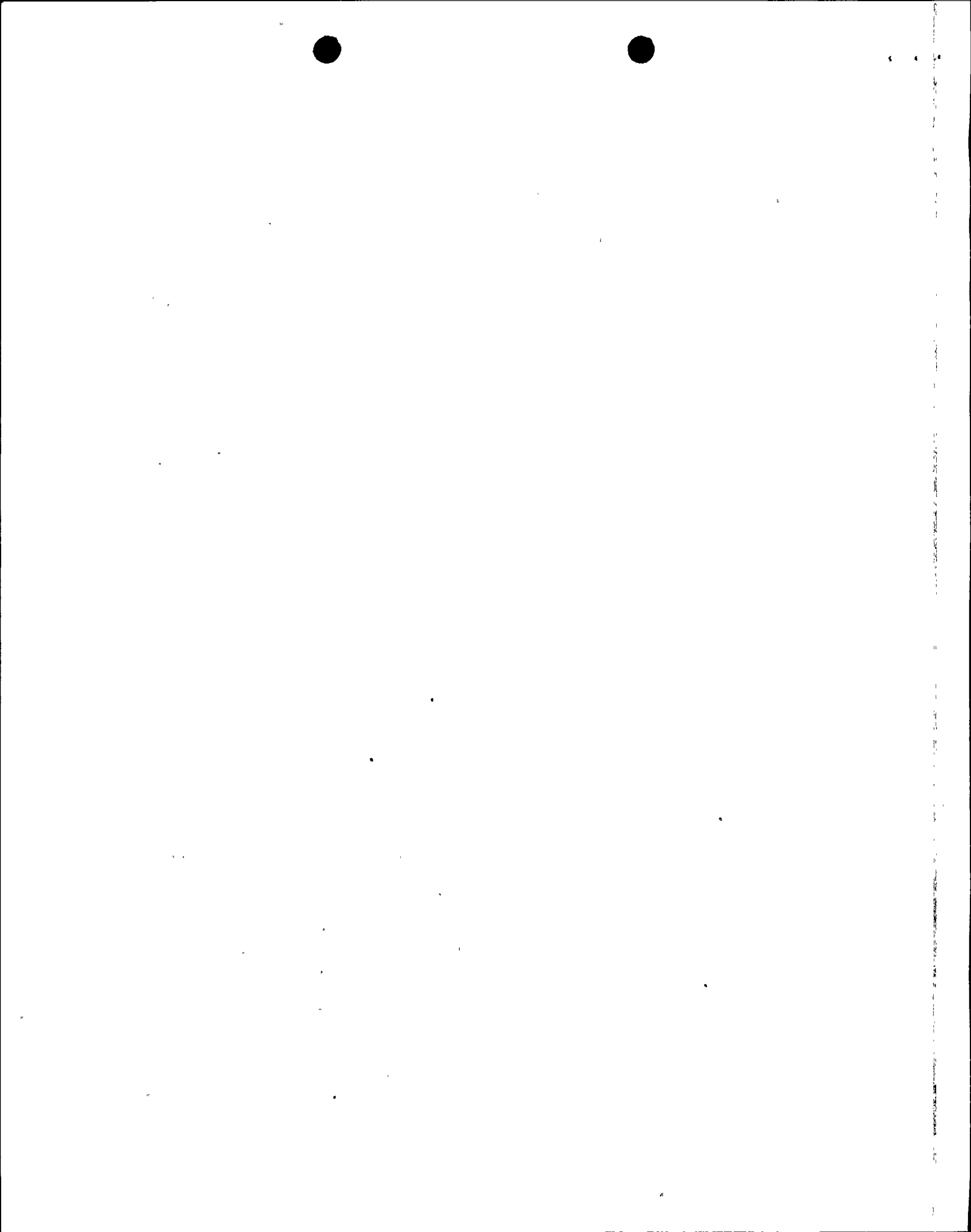
5. Requests

(a) Was the subject of offshore surveys considered in the AEC License proceedings for Diablo Canyon Nuclear Units 1 and 2?

(b) If offshore surveys were considered please indicate to what extent the matter was covered in the proceeding? Supply reference material including witnesses, testimony, and statements made.

Response

The subject of offshore surveys did not become an issue in the AEC License proceedings for construction permits for Diablo Canyon Nuclear Units 1 and 2.



6. Requests

What offshore fault surveys were considered in the certificate proceedings of the California Commission? Please furnish reference material including testimony by witnesses or statements by the parties.

Response

So far as PGandE is aware, offshore marine surveys were not discussed in the CPUC certificate proceeding.

7. Request

For witnesses that testified for applicant and other parties in A-49051 filed December 23, 1966, and A-50028 filed February 16, 1968 re certificates for the Diablo Units No. 1 and No. 2 respectively, please prepare position statements on (1) seismic activity, and (2) other major considerations in site location and selection.

8. Request

Furnish summaries of all testimony by witnesses noted in Item No. 7 above.

Response

A. Requests 7 and 8 both concern testimony in A-49051 and A-50028. PGandE has extracted from the transcript in those cases testimony, apparently pertinent to the subject matter of this inquiry, from its principal witnesses (either company employees or consultants). Those extracts are contained in Exhibit "K". Following is a list of those witnesses and a summary of the matter concerning which they testified. In most cases these transcripts are in the form of cross-examination since prepared



100



100

100

testimony was in the form of the reports entered as exhibits and contained in Exhibits "B-G".

1. Mr. H. Ray Perry testified on the need for additional power resources, particularly in the southern part of PGandE's system, and on the economics of the proposed plant.

2. Mr. Barton Shackelford testified on site selection and summarized the geological and seismological studies on the Diablo Canyon site. He also discussed advantages and disadvantages of possible alternate sites.

3. Dr. Richard Jahns testified that the Diablo Canyon site, as far as geologic considerations are concerned, is suitable for the intended use. He answered questions on the interpretation of his report (Exhibit "D") and Dr. Micheli's report (Exhibit "B"). He also discussed limited examination of alternate sites.

4. Dr. Stewart Smith testified on the possible seismic events that might affect Diablo Canyon and answered questions on his report (Exhibit "E").

B. Since the requests include references to non-PGandE witnesses, Exhibit "K" also includes statements of other significant witnesses and the subject matter of their testimony:

1. Kathleen Jackson testified on choice of Diablo Canyon over Nipomo Dunes for ecological reasons and on chronology of cooperative venture to find Diablo Canyon site.

2. Judge Hugo Fisher testified on:

- (a) establishment of task force for power plant siting within State Resources Agency;
- (b) agreement between Agency and PGandE; and



1 1

1 1

(c) his authority to enter into agreement.

3. Telegram was read into record from Sierra Club National President George Marshall reporting resolution that Nipomo Dunes remain unimpaired and that Diablo Canyon is a satisfactory alternate.

4. Mrs. Clare Hardham testified on botany of Diablo Canyon compared to Nipomo Dunes.

5. George L. Collins, Vice President of Conservation Associates, testified on:

- (a) chronology of shift from Nipomo Dunes to Wild Cherry Canyon to Diablo Canyon;
- (b) their support for application 49051; and
- (c) alternate sites.

6. Mr. Harold Bissell, Marine Biologist for the State of California, testified on his participation on the State Resources Agency Task Force which studied Diablo Canyon and alternate sites.

7. Mr. Gene Blanc testified for the State of California in his capacity as Coordinator of Atomic Energy Development and Radiation Protection, expressing strong support for the Diablo Canyon plant.

C. The above testimony is all related to the Unit 1 application (A-49051). Testimony on use of the Diablo Canyon site for Unit 2 (A-50028) was more limited. However, supplementary reports on geology, seismology and earthquake design criteria were introduced into the record of that proceeding and are also included in Exhibit "K".



3
1
1

1
1
1

1
1
1

9. Requests

Subsequent to the PG&E and/or seismic consultants evaluation noted in Item 4, furnish the following:

- (a) A summary of ongoing seismic developments to date.
- (b) Evaluation of the seismic developments to date, including consideration of various alternatives, e.g., suspension of construction.
- (c) Justification of the courses of action taken to date.

Response

The following is a summary of ongoing investigatory and regulatory events.

During the interval between issuance of the Unit #1 certificate in November 1967 and issuance of the Unit #2 certificate in March 1969 some further work was performed directed to the Unit #2 application. In 1970 some work was done with respect to analyzing assertions with respect to the Edna fault and offshore epicenters. This issue was largely resolved by the U.S.G.S.'s supplemental report referenced in an earlier footnote.

In late 1972, Mr. Douglas Hamilton of Earth sciences Associates (a consultant firm retained to assist Dr. Jahns) learned of an article in Memoir #15 of the American Association of Petroleum Geologists, published in 1971. This article indicated the presence of a fault (since named the Hosgri Fault) some 4-5 miles off-shore from Diablo Canyon. The article was authored by Ernest G. Hoskins and John R. Griffiths, Shell Oil Company geologists. They reported on off-shore surveys done in connection with oil exploration performed by Shell during the mid-1960's along the central and northern California coast. The work was a survey



Vertical text along the right edge of the page, possibly a page number or margin indicator.

of conditions at considerable depth beneath the ocean floor to study large off-shore basins. Mr. Hamilton called PGandE's attention to the paper and its map.

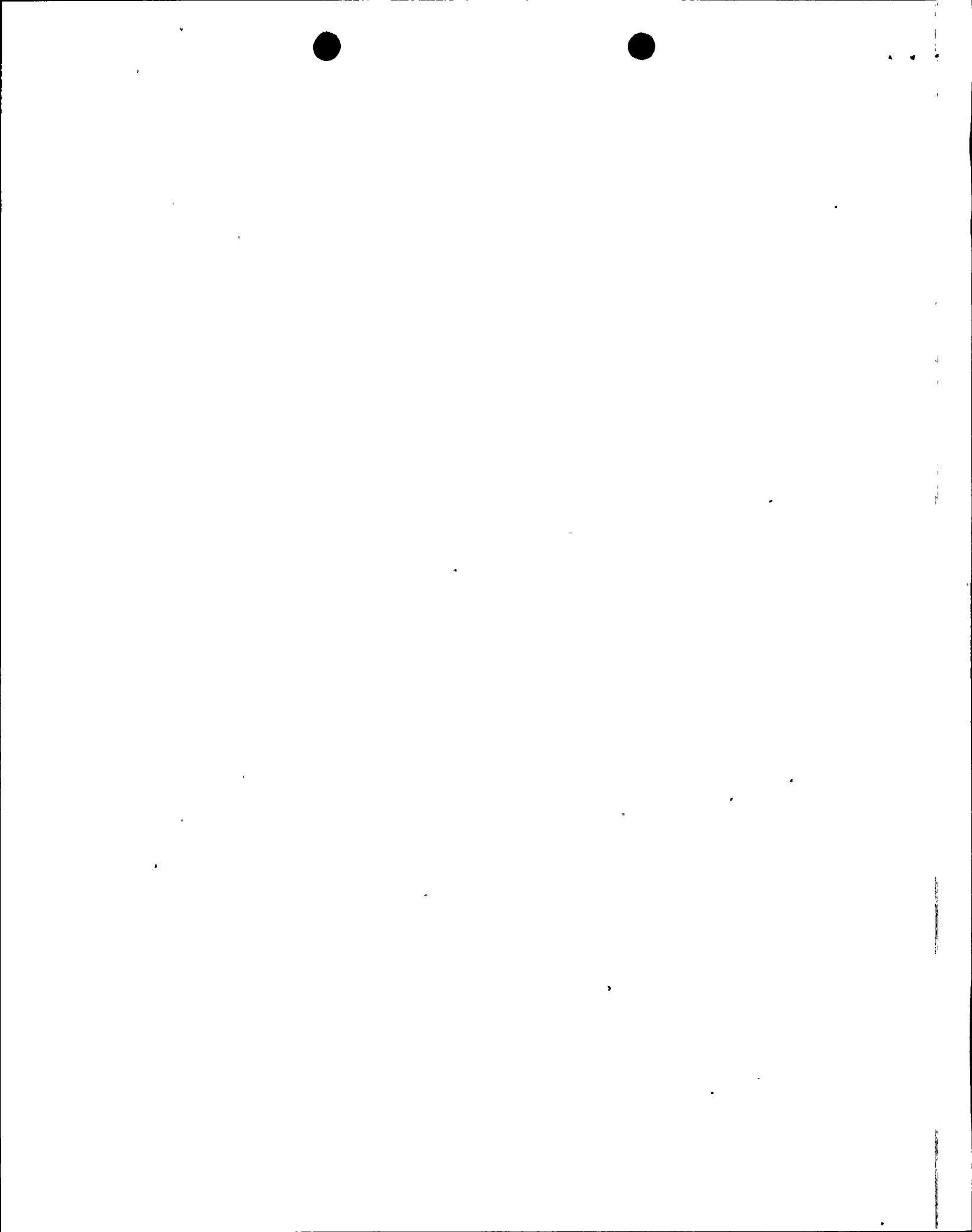
Given the information developed in its earlier geologic and seismologic investigations, these features did not appear significant in terms of the design criteria for the plant. Nevertheless, investigation continued.

In February, 1973, Mr. Hamilton was able to contact Mr. Hoskins and discuss the Shell surveys. A month or so later, at PGandE's request, Mr. Hamilton visited the Shell office in Los Angeles and reviewed some of the data used in the paper. These data suggested that the faulting described by Hoskins and Griffiths in the Diablo Canyon vicinity was relatively old. Since the seismic record of the area also suggested, at most, a low level of seismic activity, the allowances made in the design for an assumed large earthquake beneath the site were judged to be fully capable of accounting for any events associated with this new feature.

However, the Hoskins and Griffiths work was additional relevant geologic information and when PGandE's Final Safety Analysis Report (FSAR) was submitted to the AEC during the summer of 1973, it included a description of the off-shore fault mapped by Hoskins and Griffiths, including the indications of minor seismic activity possibly associated with it.

During the AEC's review of the FSAR they requested further information about the fault that had been mapped by Hoskins and Griffiths.

PGandE then learned that the USGS, in connection with an ongoing program of coastal research funded by the AEC, was

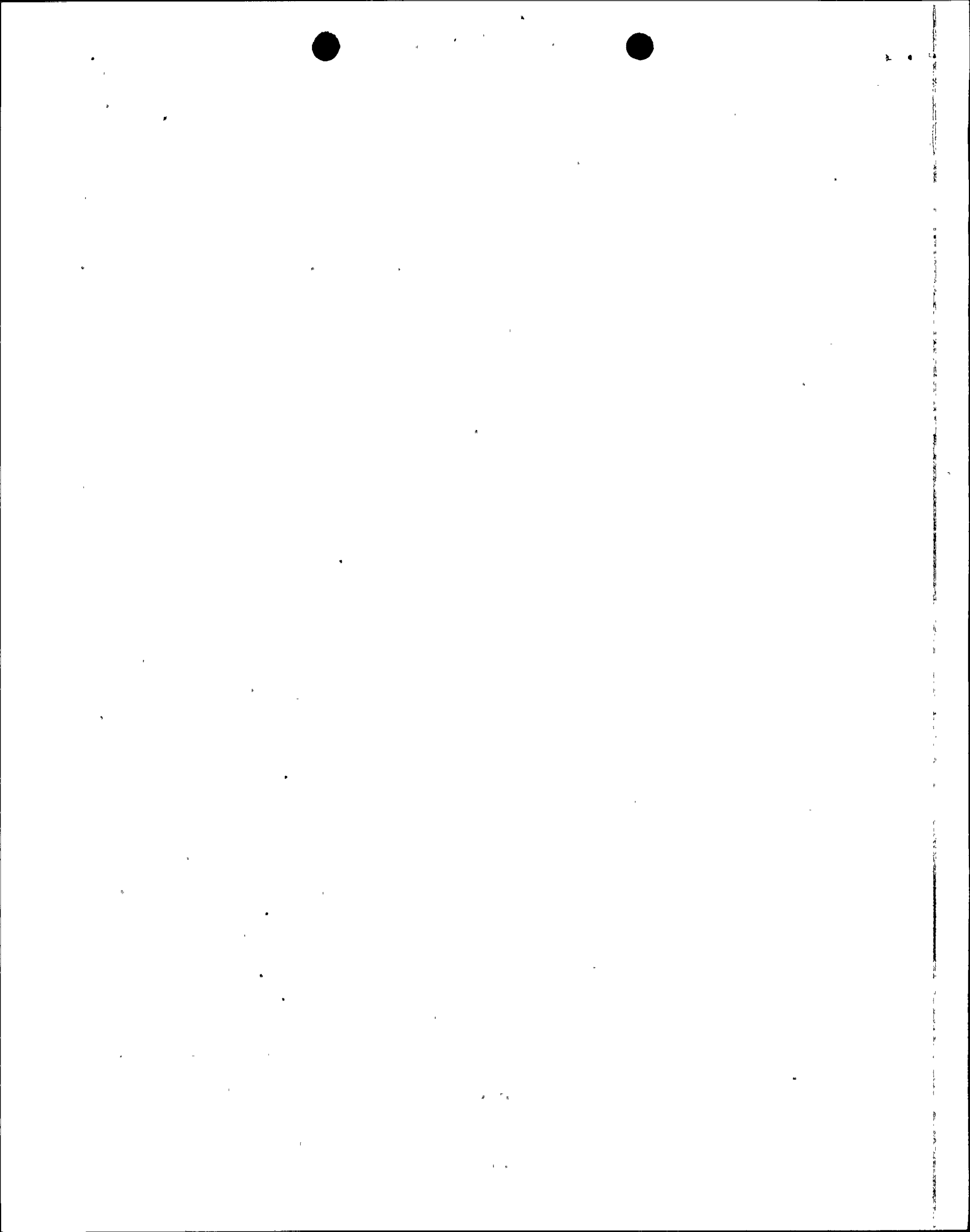


planning to conduct survey work specifically directed to the central California coastal region, including the Diablo Canyon vicinity. This work was in fact performed by the survey ship Kelez in October-November, 1973.

PGandE learned in mid-November, through the media, that the USGS work supposedly disclosed indications of surface faulting at the sea floor. After consultation with the USGS, PGandE commissioned its own survey to supplement their information and to clear up possible confusion over the nature of the sea floor scarp identified in the press as a "surface fault." The Company's findings and those of USGS were reviewed at a meeting with the AEC staff in January, 1974, specifically in relation to three local faults mapped by the USGS. In its report of that meeting, the staff concluded that one of those faults might be related to the larger structure mapped by Hoskins and Griffiths; however, they felt that any ground motions produced at the site by an earthquake on any of these faults would be well within the limits for which the plant was designed.

The Company, reinforced by the exhaustive studies and opinions of its consultants, remains convinced that the Hosgri Fault cannot reasonably be expected to generate earthquakes that will exceed the strength already built into the Diablo plant.

In December, 1974, after the Company had responded to AEC questions about the Hosgri Fault, the AEC took the position that the Hosgri Fault could affect the seismic design basis of the plant. It requested that the plant be checked for a site ground motion somewhat greater than that specified by PGandE in the original design.



Then, in January, 1975, the USGS evaluation of the Hosgri Fault was forwarded to NRC. The evaluation took the position that the new ground motion level used by the NRC was still inadequate. This contention was apparently based in part on a university senior report sponsored by USGS. This study, by student William Gawthrop, raised the possibility that the origin of the 1927 7.3M Lompoc earthquake could be reassigned to the southern end of the Hosgri structure rather than to a fault further off-shore. The Gawthrop paper was open-filed in May, 1975. After extensive review and analysis, the Company's consultants determined that Mr. Gawthrop's contention cannot be supported by either the seismological or geological data. They instead assign the Lompoc earthquake to a fault referred to as the "offshore Lompoc fault" located southwest of the Hosgri fault.

The NRC requested additional information about the 1927 earthquake and other matters in light of the USGS evaluation of January, 1975. This information was developed using further off-shore data which had subsequently been open-filed by the USGS and proprietary data which was purchased, together with additional seismological studies by Dr. Stewart Smith.

In December of 1975, Dr. Clarence Hall published a paper which suggested extensive movement along the Hosgri Fault. PGandE consultants reviewed this paper and did additional field work to check some of the evidence cited. They were then able to conclude that this postulation of large movement was precluded by other evidence. In April, 1976, after the Company had submitted to NRC considerable additional information and had participated



1 1 1

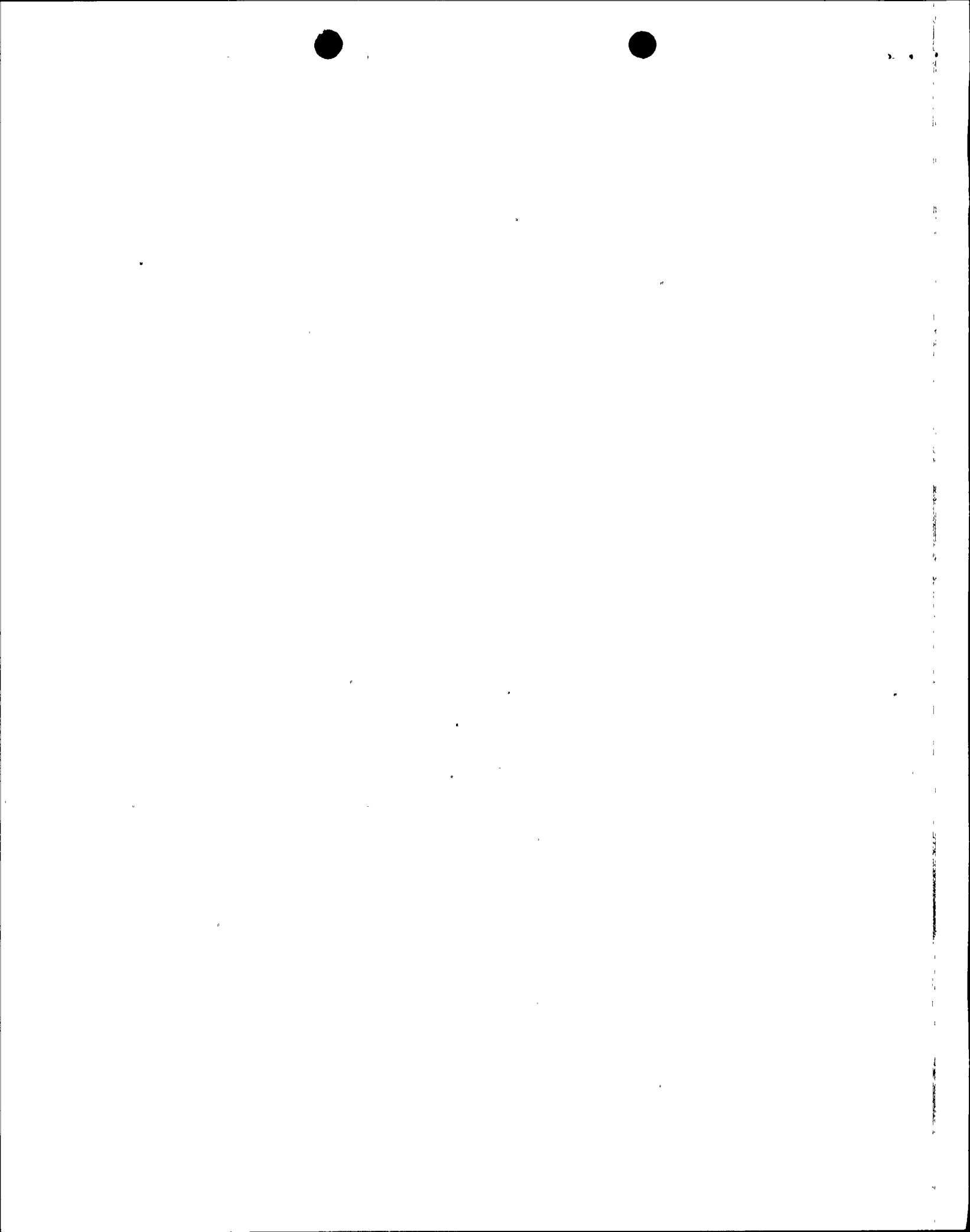
1 1 1

in numerous discussions with its staff, a further USGS evaluation was given to NRC. In this evaluation, USGS repeated its position as set forth in January, 1975, but this time recommended a specific earthquake be considered on the Hosgri Fault. The ground motion at the site from this postulated earthquake was substantially more severe than the already higher values studied in December, 1974, at the AEC's request. The NRC accepted this April, 1976, assessment and asked the Company to provide an appropriate evaluation of the plant. PGandE and its consultants believe that the earthquake parameters selected by USGS and the resulting ground motion values are unreasonably high.

Nevertheless, in an effort to get this vitally necessary plant licensed without further delay, the Company has undertaken the requested analysis. The seismic criteria for the evaluation were prescribed by the NRC staff in May, 1976. These criteria were the subject of several meetings by the Diablo Canyon subcommittee of the NRC's Advisory Committee on Reactor Safeguards (ACRS) and the ACRS itself.

In December, 1976, the ACRS, by letter, requested the NRC staff and the Company to respond to the comments of their consultants with respect to the criteria being used for evaluation.

Early in June, 1977 the Company filed with the NRC Amendment 50 to the FSAR, a four-volume partial report on the evaluation and response to the comments of the ACRS consultants. This material was presented to the ACRS subcommittee in a three-day meeting late in June, with the hope that the subcommittee might take the necessary action for the matter to move to the full



committee by its August or September meeting. However, the ACRS will not act until it reviews a report of the NRC staff which will be completed following a filing of additional studies requested of the Company. The Company now believes that an ACRS meeting on seismic issues can be scheduled this fall and that further licensing procedures can go forward expeditiously.

The Company estimates that Unit No. 1 could be made critical within 45 days after receiving permission to load fuel. In another 30 days it could reach full power.

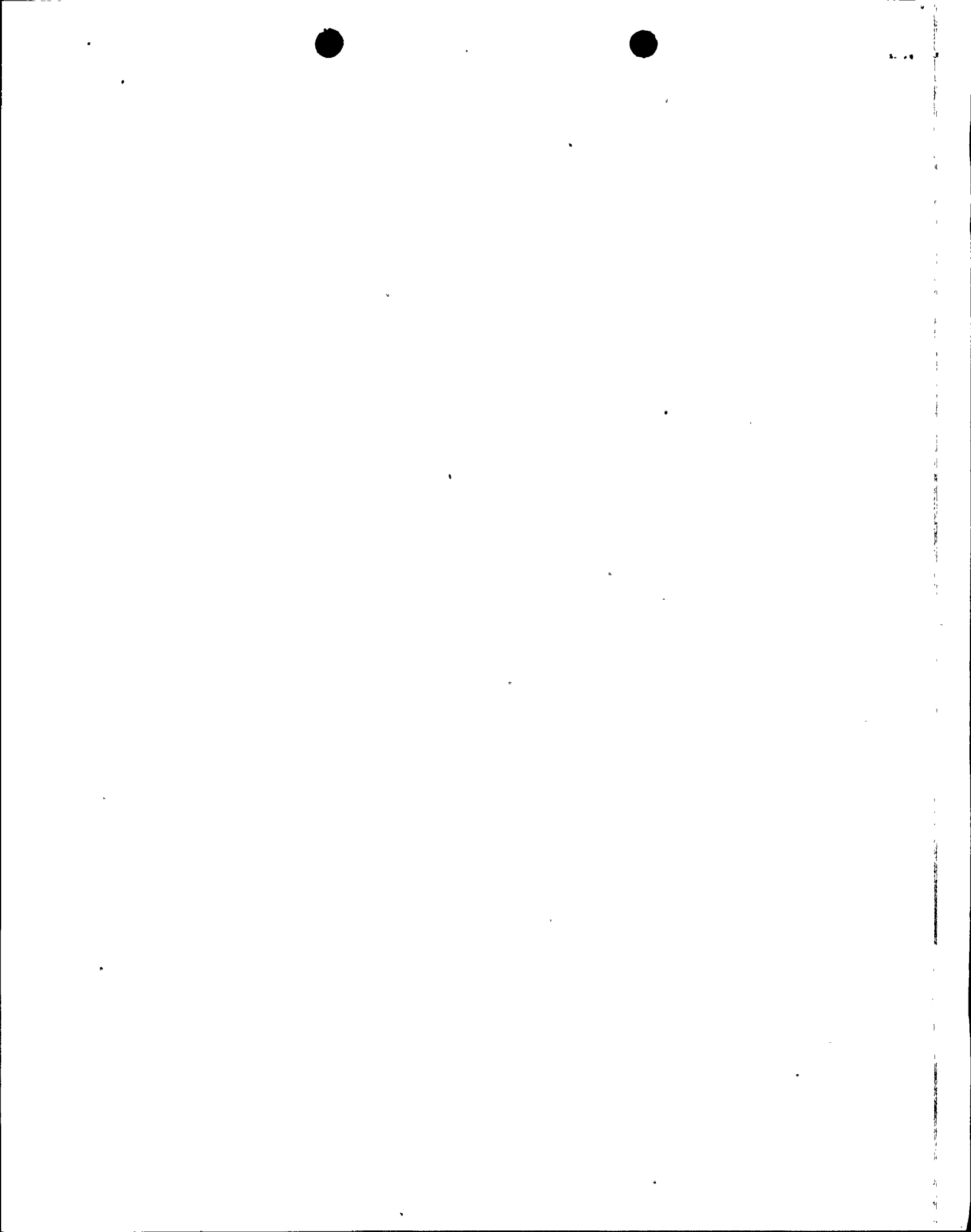
In April and again in November of 1974 the NRC denied requests by intervenors that work on the project be halted. In view of the facts as PGandE has known them, facts which have always supported the conclusion that this plant will safely and successfully perform its assigned tasks; work stoppage, either in 1974 or at some other point, has not been considered a logical alternative. Indeed, the growing need for the addition of this plant's capacity has rendered stoppage increasingly unacceptable.

9(d) Request

Evidence that the Board of Directors conducted a knowledgeable executive evaluation of alternatives and selection of the adopted course of action.

Response

The Company's management kept the Board of Directors fully informed on the status of the Diablo Canyon Project. The only formal action taken by the Board of Directors or Executive Committee, and thus reflected in the minutes, was approval of estimates of construction expenditures and subsequent revisions



thereof.

9(e) Request

Re-evaluation programs newly implemented or contemplated.

Response

The first phase of the Hosgri seismic evaluation program currently underway [as described in the response to Requests 9(a)-(c)] is reported at length in Amendment 50 to the FSAR. A copy of this amendment has been furnished to the CPUC, as have all other amendments and the FSAR itself. Reference is made to this amendment in response to this Request 9(e).

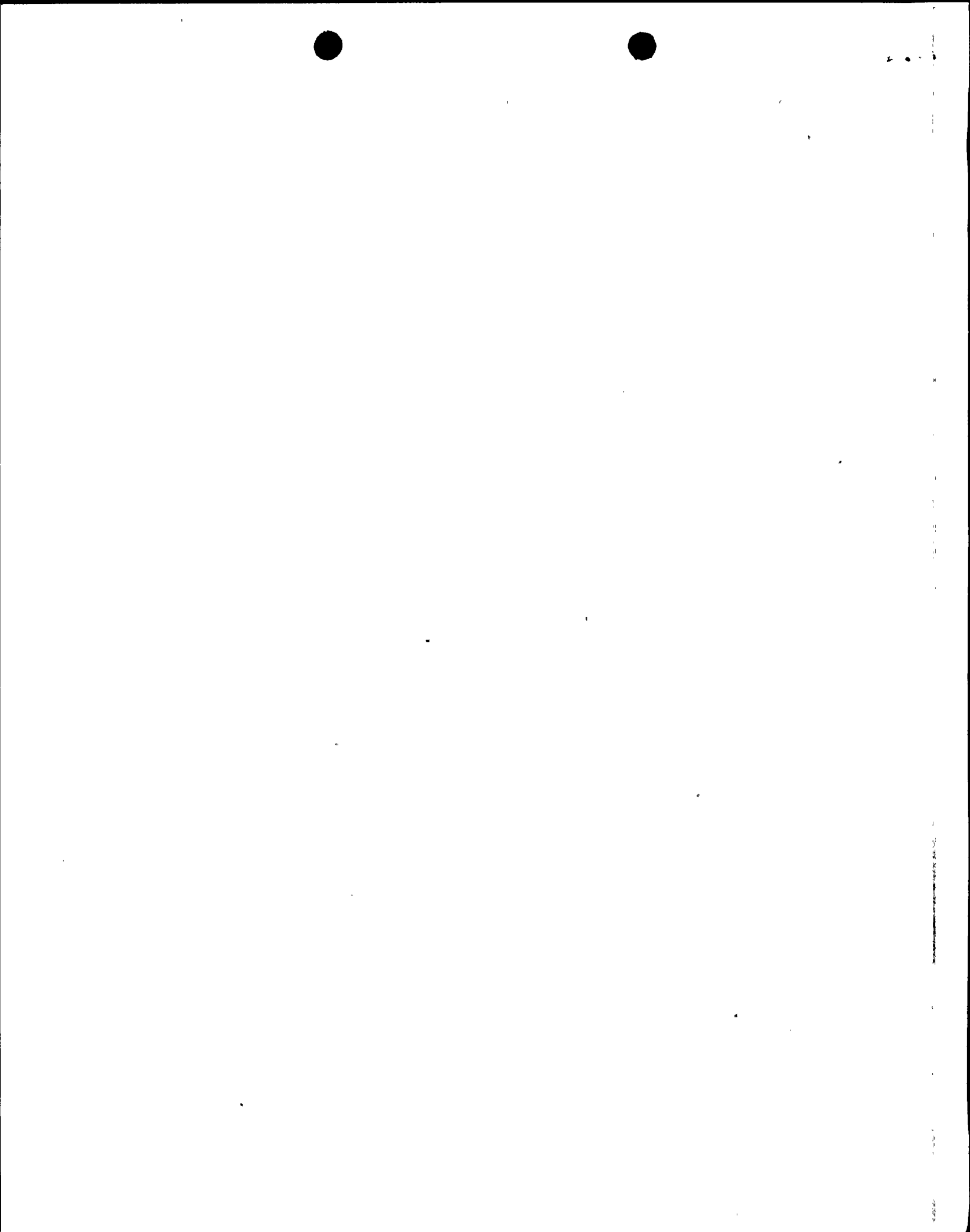
10. Request

For Diablo Canyon Units No. 1 and No. 2 separately furnish the following:

- (a) Original estimate of total plant expenditures and operating date.
- (b) Estimates of total plant expenditures and operating date as presented in the certificate proceedings before the California Commission.
- (c) End of calendar year expenditures by year from start of construction to date.
- (d) End of calendar year estimates of total costs for plant completion by year from start of construction to date.
- (e) End of calendar year estimates of operative plant date by year from start of construction to date.

In setting out the above estimates, segregate the costs into the following categories:

- (i) Preliminary Surveys



- (ii) Planning and Design
- (iii) Site Preparation and Mobilization
- (iv) Substructure and Foundation
- (v) Superstructure and All Related Costs
- (vi) Equipment and Related Supplies, e.g., Turbine, etc.
- (vii) General Overhead

AFDC

Ad Valorem Taxes

Overhead (General Engineering and Administration)

Response

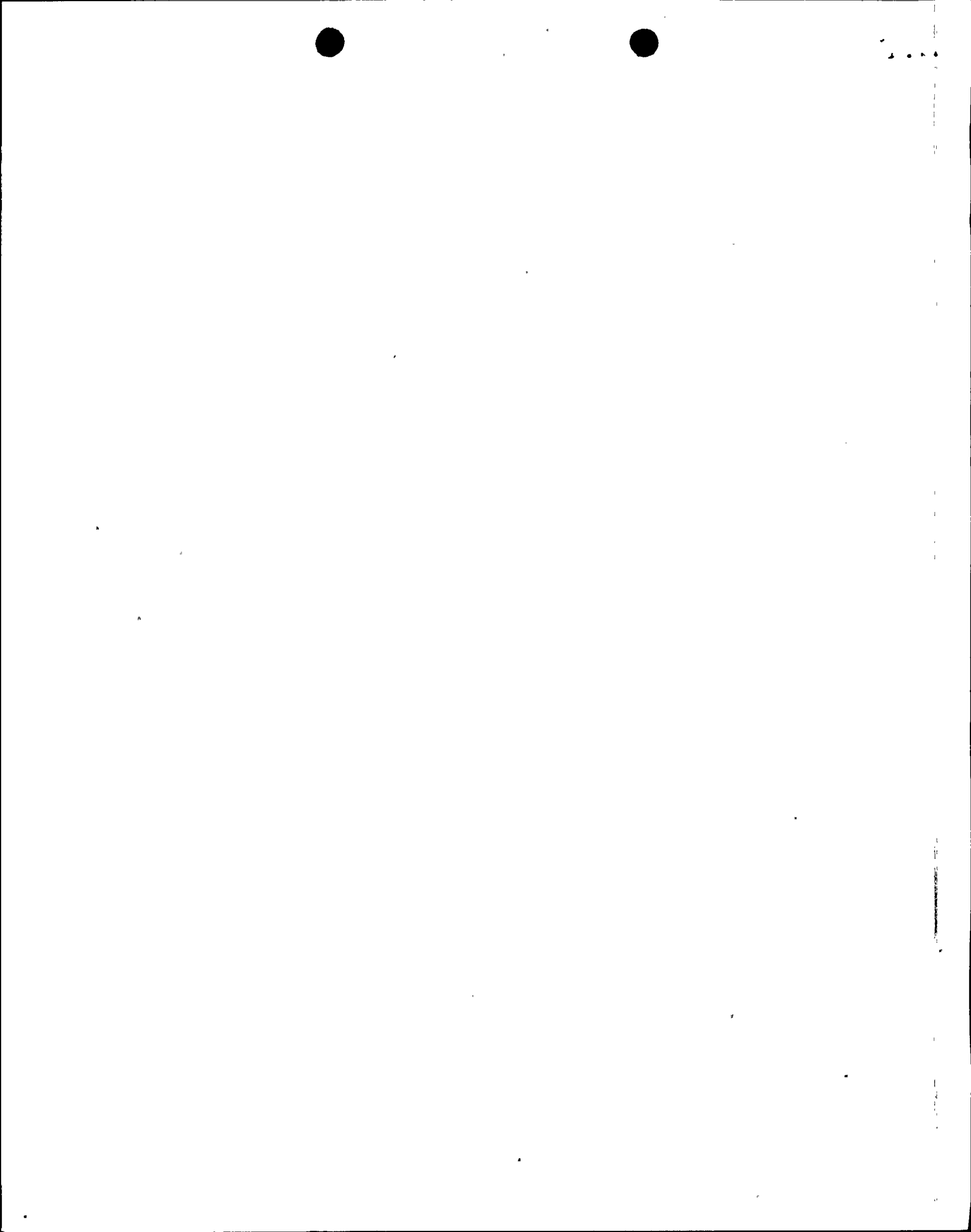
PGandE prepares estimates and segregates costs based on established accounting practices under the applicable Uniform System of Accounts prescribed for public utilities by the Public Utilities Commission of the State of California. PGandE's accounting system, which is based on FPC Accounts, does not differentiate between categories (i) through (vi). It would be extremely difficult and time consuming to segregate costs into these categories. For this reason, end-of-calendar-year estimates are broken down by PGandE accounting system and category (vii). See Exhibit "L" for response.

11. Request

With reference to the revisions of costs and starting dates set out in Item 10 above, furnish the basis for each revision including the effects on each cost element.

Response

See Exhibit "L" for this response.



12. Request

With reference to Item 10 above, set out the development of revised seismic structural design criteria and commensurate design changes and costs from the original design through to the most current contemplated design.

Response

The seismic structural design criteria for the Diablo Canyon plant are described in Chapters 2 and 3 of the FSAR. The plant has now also been evaluated for a postulated 7.5M Hosgri earthquake. This evaluation is documented in Amendment 50 to the FSAR. The seismic structural design criteria for this evaluation are described in Section 4.1 Volume 1. Until the NRC review is complete, it is not possible to set an exact cost for required design changes. However, Table R-12 to Amendment 50 shows the design changes currently seen as resulting from the Hosgri evaluation preliminary cost estimates for their implementation (including projected engineering, testing, and construction). These preliminary estimates are as follows:

<u>Design Changes</u>	<u>Cost (Order of Magnitude)</u>
Turbine Building Structural Modifications	\$20,000,000
Auxiliary Building Structural Modifications (All in Fuel Handling Area)	500,000
Electrical Equipment	1,000,000
Mechanical Equipment	<u>1,500,000</u>
TOTAL	\$23,000,000

