



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

February 10, 1992

Mr. John Beccia
Star Rte., Box 235
Santa Margarita, CA 93453

Dear Mr. Beccia:

By letter dated September 15, 1991, you stated that you believe that an earthquake study of Diablo Canyon should be done by an independent scientific organization such as the U.S. Geological Survey. This letter is in response to your letter.

The seismic adequacy of nuclear power plants such as Diablo Canyon is a matter of continuing interest to the NRC. For this reason, when the NRC issued the Operating License for Diablo Canyon Unit 1, the license included a condition requiring Pacific Gas and Electric Company (PG&E) to conduct a reevaluation of the seismic adequacy of the plant. The license condition required a reevaluation of all aspects of the seismic design of the plant, including geology, seismology, engineering, and probabilistic risk studies.

The PG&E reevaluation, called the Long-Term Seismic Program (LTSP), was completed and a final report on the LTSP was issued by PG&E in July of 1988. From the beginning of this reevaluation program the NRC staff has closely scrutinized PG&E's activities. This included holding about 50 public meetings with PG&E to discuss seismic issues, participating in geologic field trips, and independent studies by NRC consultants. This NRC oversight frequently led to the NRC staff asking PG&E to expand the scope of its effort or perform additional studies to resolve technical issues.

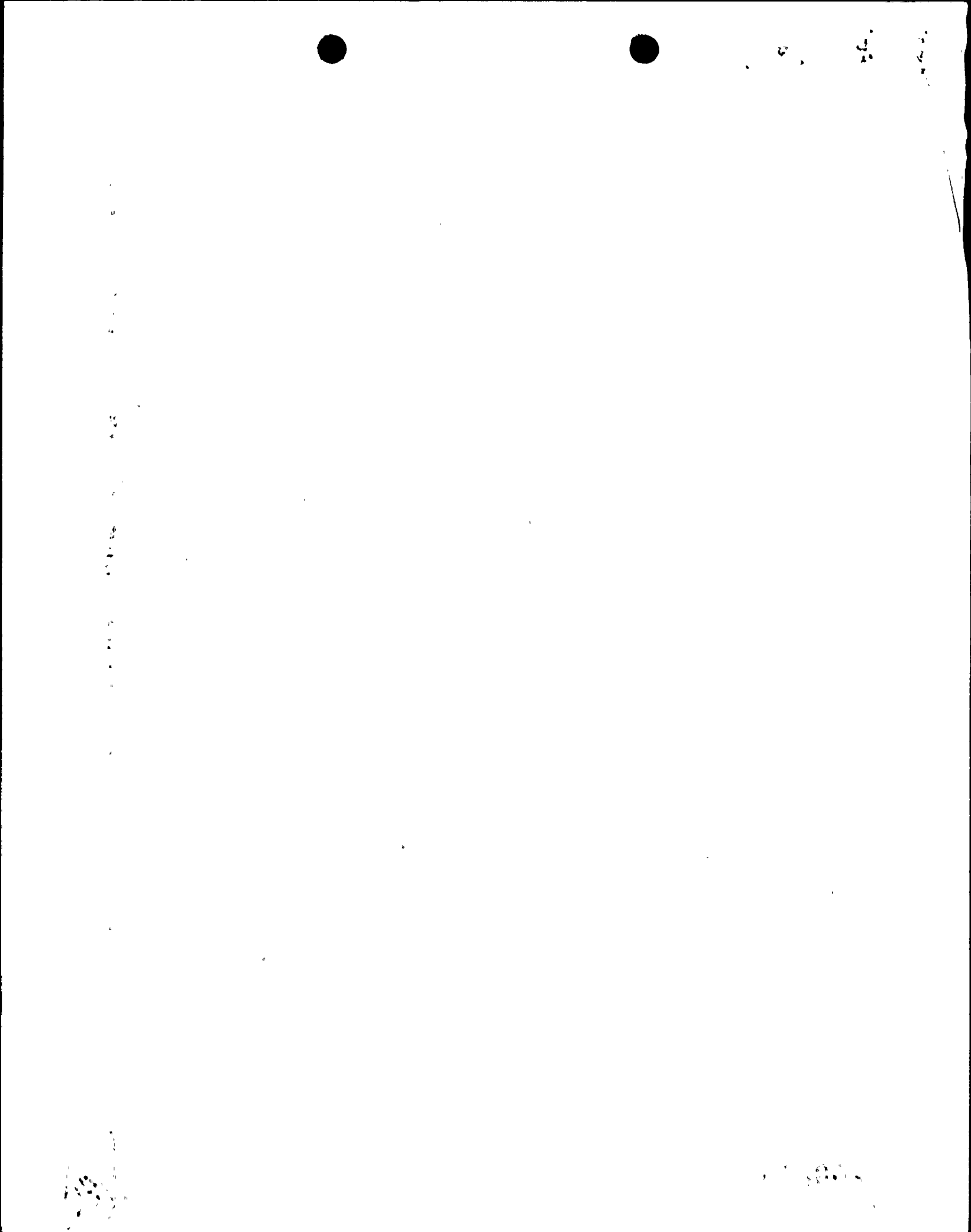
Following the completion of the LTSP, the NRC staff and its consultants conducted a thorough, detailed, and independent review of the LTSP. During the course of the staff review, several hundred written technical questions about the LTSP were originated by the NRC staff and its consultants, and responded to by PG&E. The NRC staff's review was documented in Supplemental Safety Evaluation Report Number 34 (SSER 34), issued on June 6, 1991 (the summary section of SSER 34 is enclosed). Contrary to some descriptions in the local press about SSER 34, it did not "re-issue" the LTSP Final Report. Rather, it is a critique of the LTSP, and includes appendices that present the opinions of some of the staff consultants, including the U.S. Geological Survey. In SSER 34 the NRC staff concluded that, subject to the completion of a minor confirmatory item, PG&E has met the license condition that required a reevaluation of the Diablo Canyon seismic design.

The seismic safety of nuclear power plants is a complex subject, involving a number of scientific and engineering disciplines. For this reason, the NRC review of the LTSP involved a wide variety of technical experts, including members of the NRC staff and consultants to the staff. The staff selected its consultants for their expertise in each of the specific disciplines involved.

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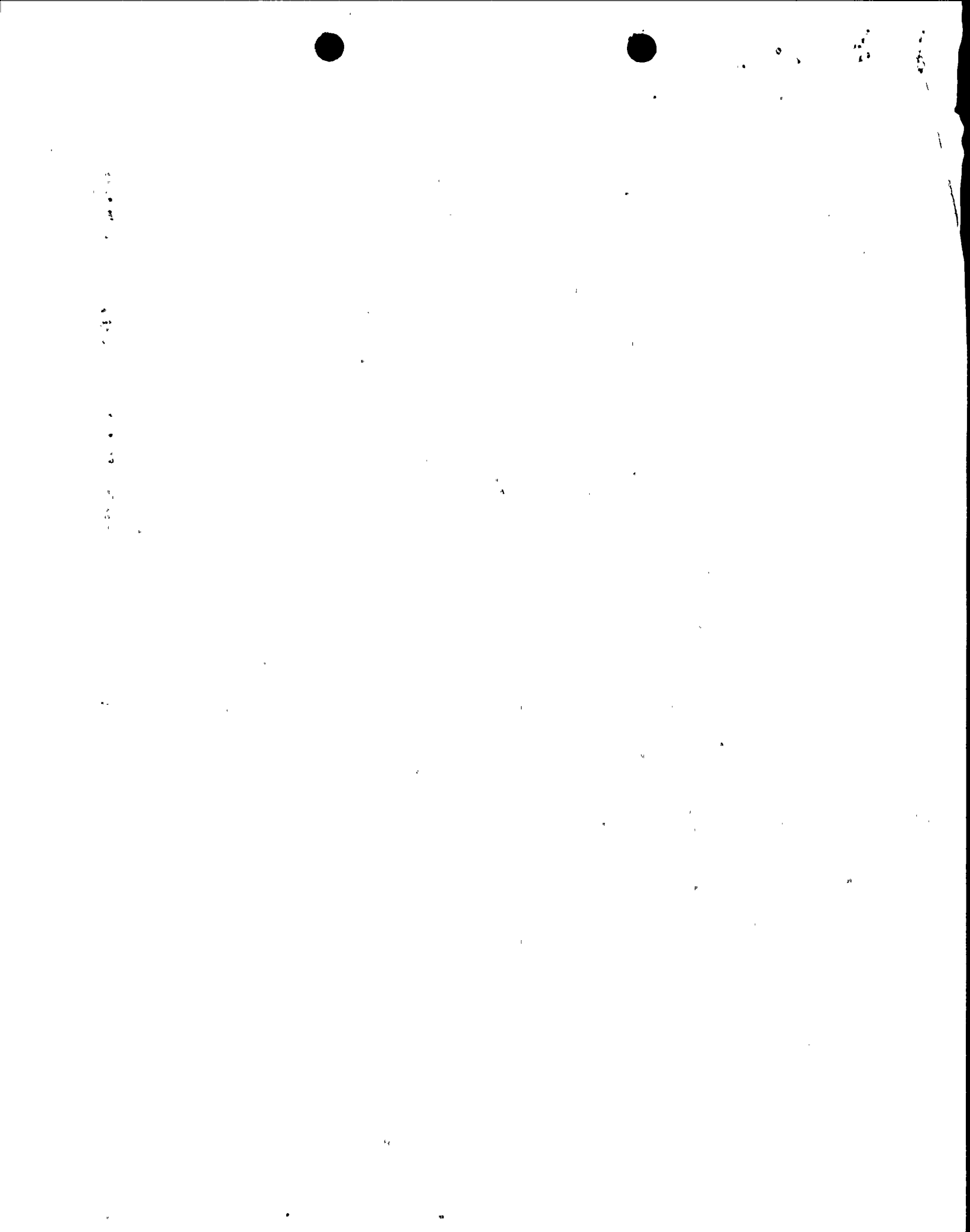


For example, the U.S. Geological Survey was used as a consultant in the areas of geology and seismology, and Brookhaven National Laboratory was used in the areas of systems analysis and probabilistic risk analysis.

In addition to spending over 11,500 person-hours of effort by NRC staff technical experts to review the LTSP, the staff contracted with a number of technical consultants to conduct independent studies related to the seismic safety of Diablo Canyon. Specifically, in the geosciences area the NRC funded development by the U.S. Geological Survey of interpretations of seismic reflection profiles from the Santa Maria Basin, and the evaluation of a number of central California earthquakes. Also, the NRC funded studies by the University of Nevada-Reno of the regional geology of central coastal California, and the geology of the San Luis-Pismo block, the San Simeon area, and the Casmalia-Orcutt area. Finally, in the geosciences area the NRC funded regression analyses of strong motion data from large earthquakes. The regression analyses were conducted by an employee of the U.S. Geological Survey who, during the course of his analyses, resigned from the Survey and accepted employment with Dames and Moore, a private consulting firm. In the area of seismic engineering the NRC funded an independent analysis of soil-structure interaction of the Diablo Canyon containment building by a consultant from Rice University. In the area of probabilistic risk assessment the NRC funded a number of independent studies by Brookhaven National Laboratory and Sandia National Laboratory, and by EQE, a private consulting firm.

On the basis of the independent studies conducted by NRC staff consultants including the U.S. Geologic Survey, as well as the independent review of the LTSP by the NRC staff and its consultants, the NRC staff concluded that (1) PG&E has met the license condition requiring a seismic reevaluation of Diablo Canyon, and (2) the Diablo Canyon seismic design has been validated and continues to be acceptable.

The LTSP, the NRC staff review of the LTSP, and the independent studies conducted by the staff have also been reviewed by the NRC's Advisory Committee on Reactor Safeguards (ACRS). The ACRS is an independent advisory committee by the Atomic Energy Act of 1954 that reports to and advises the Commission, and is separate from the NRC staff. As may be seen from the ACRS letter on the LTSP (see Enclosure 2), the ACRS concurs with the NRC staff conclusion that the license condition requiring PG&E to conduct the LTSP has been met. The ACRS letter further concludes that (1) the seismic margins for the plant are adequate and quite comparable to those for other plants in the United States, (2) the Probabilistic Risk Assessment (PRA) showed no significant seismic vulnerabilities, and (3) Diablo Canyon can be operated without undue risk to the health and safety of the public.



Mr. John Beccia

In view of the studies conducted by PG&E, the review of the PG&E studies by the NRC staff and its consultants, the independent studies conducted by NRC consultants, and the independent review of the PG&E studies and the NRC staff studies conducted by the ACRS, all of which are essentially in agreement, we conclude that yet another independent study of the seismic design of Diablo Canyon is not warranted.

With regard to your remark that PG&E kept information of the discovery of the Hosgri Fault from the public for six years, this issue was addressed by PG&E during the course of a congressional oversight hearing held on June 30, 1977. At that hearing, PG&E stated that in late 1972, a PG&E consultant learned of an article in the scientific literature published in January, 1971 (the Hoskins and Griffiths paper) which indicated the presence of the Hosgri Fault. This information was included in the Diablo Canyon Final Safety Analysis Report (FSAR), submitted to the NRC's predecessor agency, the Atomic Energy Commission, in the summer of 1973. The FSAR was placed in the AEC's Public Document Room soon after submittal. We know of nothing that would indicate that the PG&E congressional testimony is incorrect, or that PG&E knew of the existence of the Hosgri fault prior to the publication of the Hoskins and Griffiths paper.

Sincerely,
Original signed by

Bruce A. Boger, Director
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

Enclosures:

- 1. SSER 34 Summary
- 2. ACRS letter dated 10/18/91

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THE UNIVERSITY OF CHICAGO
DEPARTMENT OF CHEMISTRY
5800 S. UNIVERSITY AVENUE
CHICAGO, ILLINOIS 60637

RECEIVED
JAN 15 1964
FROM
DR. J. H. GOLDSTEIN
SUBJECT
POLYMERIZATION OF VINYL MONOMERS
BY CATIONIC MECHANISM

TO
DR. J. H. GOLDSTEIN
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CHICAGO, ILLINOIS 60637

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- 3 -

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Sincerely,



Bruce A. Boger, Director
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1 INTRODUCTION AND SUMMARY

1.1 Background

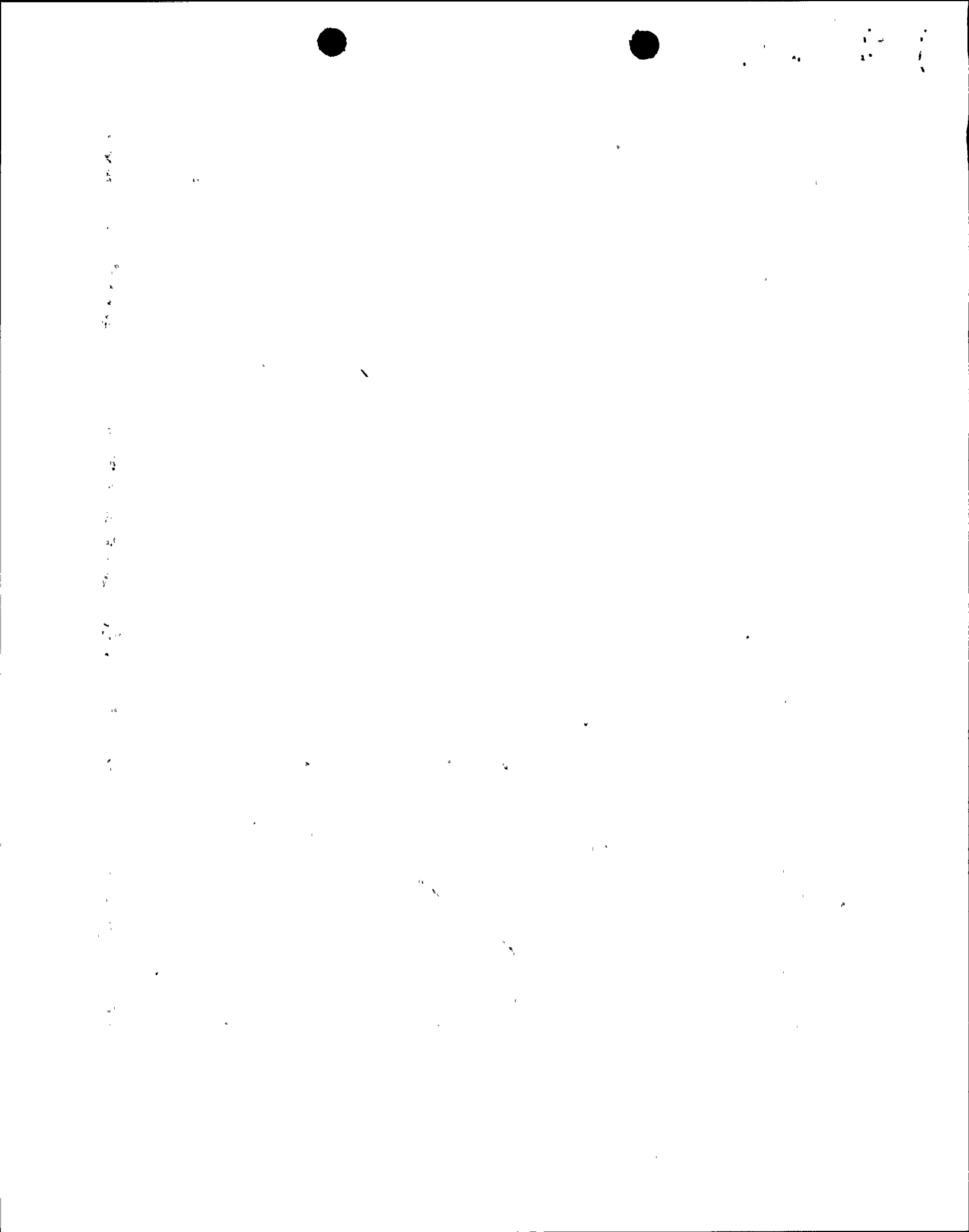
The two nuclear units at the Diablo Canyon Nuclear Power Plant (Diablo Canyon) are substantially identical pressurized-water reactors. Each unit consists of a Westinghouse-designed nuclear steam supply system (NSSS) in a four-loop reactor coolant system, with a turbine generator, auxiliary equipment, and associated controls and instrumentation. The NSSS for each unit is contained within a steel-lined, reinforced-concrete structure that is capable of withstanding the pressure that might be developed as a result of the most severe design-basis loss-of-coolant accident. Units 1 and 2 are licensed to produce 3338 and 3411 thermal megawatts, respectively. These power levels result in net electrical outputs of 1084 and 1106 MWe, respectively. The units are owned and operated by the Pacific Gas and Electric Company (PG&E).

The Diablo Canyon plant is located on a 750-acre site on the central California coast in San Luis Obispo County, approximately 12 miles west-southwest of the city of San Luis Obispo, California. The site is roughly equidistant from San Francisco and Los Angeles, California.

The Nuclear Regulatory Commission's predecessor agency, the Atomic Energy Commission (AEC), issued a construction permit (CP) for Diablo Canyon Unit 1 on April 23, 1968, and for Unit 2 on December 9, 1970. In 1975, the regulatory functions of the AEC were assumed by the Nuclear Regulatory Commission (the Commission, or the NRC). After construction was complete, the NRC issued operating licenses (OLs) for the Diablo Canyon units. The NRC issued a full-power OL for Unit 1 on November 2, 1984, and for Unit 2 on August 25, 1985. The two units have been in operation since their OLs were issued. Unit 1 recently completed its fourth refueling outage and is back on line. Unit 2 is scheduled to be shut down for its fourth refueling outage in September 1991.

Because California is an area of relatively high seismic activity, geological and seismic issues have played a major role in the design and licensing of Diablo Canyon. Before NRC issued the Diablo Canyon construction permits, PG&E conducted geological and seismic investigations to validate the acceptability of the site. These investigations included region studies and detailed onshore site investigations consisting of trenching, core drilling, and geological mapping in the vicinity of the site. During the time of the Diablo Canyon CP review, the NRC regulation that currently governs seismic design (Appendix A to 10 CFR Part 100) was in the early stages of development, and the concepts of the safe shutdown earthquake (SSE) and operating basis earthquake (OBE) were still being developed.

At the time the CP was issued, PG&E concluded, and the AEC concurred, that the earthquake design bases for Diablo Canyon would be a peak horizontal ground acceleration (PGA) of 0.4g for safety-related structures and a PGA of 0.2g for operational-related structures. These seismic design criteria were based on consideration of two design-basis earthquakes: a magnitude 7-1/4 earthquake on



the Nacimiento fault 20 miles from the site, and a magnitude 6-3/4 aftershock at the site associated with a large earthquake on the San Andreas fault. It was also concluded at that time that there was no surface displacement hazard (capable fault) in the site vicinity. This conclusion was based on the absence of any displacement of the 80,000-year-old and 105,000-year-old marine terraces underlying the site area.

Later, while geological investigations in support of the Diablo Canyon OL applications were under way, oil company geoscientists discovered that a major zone of faulting existed a few miles off shore from the plant site. This proprietary offshore geophysical information was made public in 1971 (Hoskins and Griffith, 1971). When the Diablo Canyon Final Safety Analysis Report (FSAR) was initially submitted for NRC review in 1973, it briefly described the offshore fault zone, calling it the East Boundary Fault Zone.

During the next few years, in response to NRC staff requests for additional information, PG&E investigated this fault zone. In addition, the U.S. Geological Survey (USGS), with NRC funding, conducted numerous offshore investigations of the fault zone. The zone was later re-named the Hosgri fault after its discoverers, Hoskins and Griffith (Wagner, 1974). Based on the results of these studies, recommendations by the USGS, and the issuance of Appendix A to Part 100 (1973), the NRC required that the SSE for Diablo Canyon be established as a horizontal PGA of 0.75g based on a postulated magnitude 7.5 earthquake on the Hosgri fault 5 km (3 mi) from the Diablo Canyon site [Supplemental Safety Evaluation Report (SSER) 4, May 1976]. This is usually called the Hosgri ground motion. Subsequently, PG&E reanalyzed and upgraded the plant to accommodate the new (Hosgri) seismic design basis.

The seismic design basis for Diablo Canyon was reviewed and approved by the Commission's Advisory Committee on Reactor Safeguards (ACRS). The ACRS letter approving the seismic design of the plant was issued on July 14, 1978, and included the statement that ultimately resulted in the Long-Term Seismic Program (LTSP): "The Committee recommends that the seismic design of Diablo Canyon be reevaluated in about ten years taking into account applicable new information."

After public hearings before the Commission's Atomic Safety and Licensing Board (ASLB) and Atomic Safety and Licensing Appeal Board (ASLAB), and meetings with the Commission, OLs were issued for both Diablo Canyon units. As stated above, full-power Facility Operating License DPR-80 for Unit 1 was issued on November 2, 1984, and full-power Facility Operating License DPR-82 for Unit 2 was issued on August 25, 1985. The Unit 1 full-power OL was conditioned to require that PG&E update the geological, seismological, and ground-motion information, reevaluate the magnitude of the earthquake used to determine the Diablo Canyon seismic design basis, reevaluate ground motion expected at the site, reassess engineering and equipment response, and perform a seismic probabilistic risk assessment (PRA) and deterministic studies, as necessary. The license condition was imposed because of (1) the substantial amount of offshore exploration for hydrocarbons, (2) significant advances in geology, seismology, and geophysics that had occurred since the beginning of the site review, and (3) the ACRS recommendation quoted above.



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1.2 The License Condition

The license condition that led to the LTSP and the submittal of the LTSP Final Report was included in the Diablo Canyon Unit 1 full-power license, DPR-80, as License Condition 2.C.(7), which reads as follows:

(7) Seismic Design Bases Reevaluation Program (SSER 27 Section IV.5)

PG&E shall develop and implement a program to reevaluate the seismic design bases used for the Diablo Canyon Nuclear Power Plant.

The program shall include the following Elements:

- (1) PG&E shall identify, examine, and evaluate all relevant geologic and seismic data, information, and interpretations that have become available since the 1979 ASLB hearing in order to update the geology, seismology and tectonics in the region of the Diablo Canyon Nuclear Power Plant. If needed to define the earthquake potential of the region as it affects the Diablo Canyon Plant, PG&E will also reevaluate the earlier information and acquire additional new data.
- (2) PG&E shall reevaluate the magnitude of the earthquake used to determine the seismic basis of the Diablo Canyon Nuclear Plant using the information from Element 1.
- (3) PG&E shall reevaluate the ground motion at the site based on the results obtained from Element 2 with full consideration of site and other relevant effects.
- (4) PG&E shall assess the significance of conclusions drawn from the seismic reevaluation studies in Elements 1, 2 and 3, utilizing a probabilistic risk analysis and deterministic studies, as necessary, to assure adequacy of seismic margins.

PG&E shall submit for NRC staff review and approval a proposed program plan and proposed schedule for implementation by January 30, 1985. The program shall be completed and a final report submitted to the NRC three years following the approval of the program by the NRC staff.

PG&E shall keep the staff informed on the progress of the reevaluation program as necessary, but as a minimum will submit quarterly progress reports and arrange for semi-annual meetings with the staff. PG&E will also keep the ACRS informed on the progress of the reevaluation program as necessary, but not less frequently than once a year.

PG&E responded to the license condition by submitting a program plan for the seismic design-basis reevaluation (the Long-Term Seismic Program, or LTSP) on



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January 30, 1985. The staff reviewed the plan, and, after the plan was reviewed by the ACRS, the staff approved a modified version of the plan by letter dated July 31, 1985. PG&E then conducted the program as described in the program plan, issuing progress reports to the NRC staff in accordance with the requirements of the license condition. On July 31, 1988, PG&E submitted its final report on the Diablo Canyon LTSP (Brand, 1988). Since then, the NRC staff has met a number of times with PG&E, has made a number of requests for additional information, and has received submittals from PG&E in response (see Appendix A of this SSER, "Chronology of LTSP Review"). As a result of its review, conducted with the assistance of a number of expert consultants, the NRC staff has concluded that, subject to satisfactory analytical substantiation of the confirmatory item discussed below, PG&E has met all aspects of License Condition 2.C.(7) of Facility Operating License DPR-80.

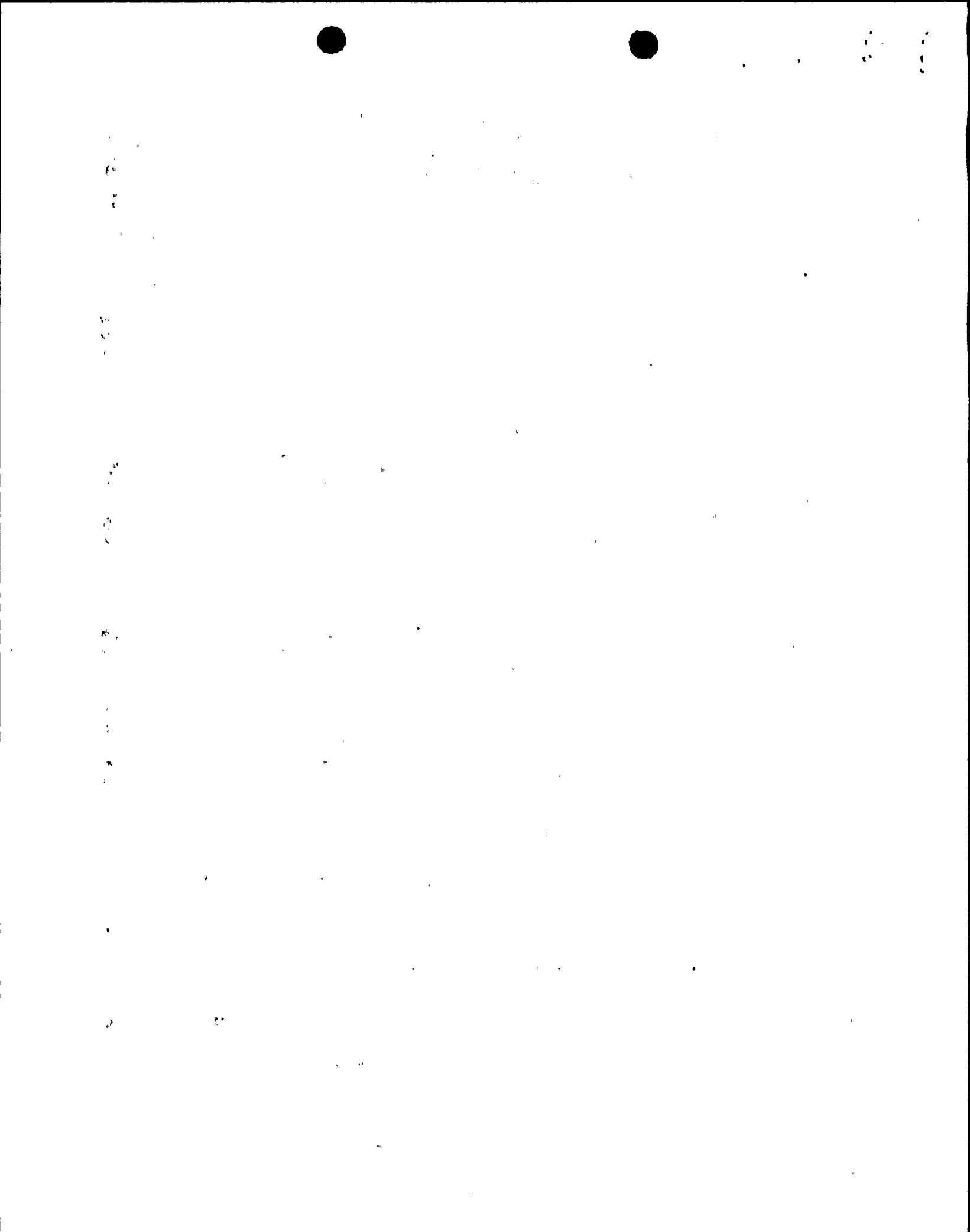
1.3 Summary of NRC Staff Review of the LTSP

1.3.1 Element 1 of the License Condition

With regard to element 1 of the license condition, the NRC staff has reviewed submittals by PG&E and concludes that PG&E has identified, examined, and evaluated all relevant geologic and seismic data and interpretations since the 1979 ASLB hearing. Further, PG&E has updated the geology, seismology, and tectonic characteristics of the Diablo Canyon region. In addition, PG&E has reevaluated selected earlier information and acquired new data relating to the earthquake potential in the region as it affects the Diablo Canyon plant.

Specifically, PG&E has conducted a program over several years, including the following:

- (1) acquisition and reprocessing of numerous oil industry seismic reflection profiles, including proprietary data
- (2) acquisition of new seismic reflection data, principally off shore, but also on shore, to fill in the gaps between existing data
- (3) analysis of deep-crust-penetrating seismic reflection and refraction lines
- (4) analysis and interpretation of well-drilling logs
- (5) investigations of onshore faults and their offshore extensions, including the San Simeon, Los Osos, Wilmar Avenue, Edna, San Miguelito, San Luis Bay, Olson, and Rattlesnake faults (these faults were investigated by geological mapping, trenching, borings, geomorphic studies, age dating, and mapping of marine and fluvial terraces)
- (6) analysis of bathymetry, sea-floor sampling, and diver exploration
- (7) installation of seismic and strong-motion networks and seismicity analysis
- (8) tsunami and seismic analyses to relocate the 1927 Lompoc earthquake and reevaluate its magnitude
- (9) empirical attenuation studies and numerical modeling to develop ground-motion estimates for the site



(10) probabilistic seismic hazards analysis

In summary, the NRC staff finds that the geological, seismological, and geophysical investigations and analyses conducted by PG&E and its consultants for the LTSP are the most extensive, thorough, and complete ever conducted for a nuclear facility in the United States, and have advanced the state of knowledge in these disciplines significantly. On this basis, the NRC staff finds that PG&E has complied with element 1 of the license condition in an acceptable manner.

1.3.2 Element 2 of the License Condition

Element 2 of the license condition requires that PG&E reevaluate the magnitude of the earthquake used to determine the seismic design basis at Diablo Canyon using the information developed for element 1. The NRC staff has reviewed the information submitted by PG&E and finds that the conclusion reached during the staff's review of the Diablo Canyon OL application, that the Hosgri fault is the seismic source that could cause the maximum vibratory ground motion at the Diablo Canyon site, is still valid. The maximum credible earthquakes that could occur on any other fault or fault zone in the site vicinity would produce smaller ground motions at the site. PG&E concludes that the maximum earthquake associated with the Hosgri fault zone has a magnitude of 7.2 and could be located on the strand of the Hosgri that is nearest the site (the closest epicentral distance from the Diablo Canyon site is 4.5 km). The NRC staff has reviewed the PG&E conclusion and finds it acceptable. On this basis, the staff finds that PG&E has met element 2 of the license condition.

1.3.3 Element 3 of the License Condition

Element 3 of the license condition requires that PG&E reevaluate the ground motion at the site with full consideration of site and other relevant effects. In order to determine the ground motion at the site, one necessary piece of data is an estimate of the style of faulting on the controlling fault. This is important because regression analyses of the empirical ground-motion database show that reverse-slip motion on the Hosgri fault would produce higher ground motion at the site than strike-slip motion, for the same earthquake magnitude. In the LTSP Final Report, PG&E concluded that earthquake motion on the Hosgri fault is best characterized as 65-percent strike-slip, 30-percent oblique-slip (midway between strike-slip and reverse-slip), and 5-percent thrust-slip (reverse-slip with a low dip angle). On the basis of its review and the advice of its consultants, the staff finds that the style of faulting on the Hosgri fault is predominantly right-lateral strike-slip, with a subordinate but substantial reverse (vertical) component. Specifically, the staff concludes that ground motion at the site should be evaluated for an earthquake on the Hosgri fault that is 2/3 strike-slip and 1/3 reverse-slip. Thus, the staff conclusion gives greater weight to the reverse-slip component of motion.

To determine ground motion at the plant site, it is also necessary to determine the attenuation of ground motion as it propagates from the earthquake hypocenter to the site. The staff has reviewed PG&E's empirical ground-motion attenuation model and numerical modeling studies and has performed an independent attenuation study to estimate ground motion at the Diablo Canyon



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site. The staff's analysis was based on the staff's estimate (described above) of the ratio of strike-slip to reverse-slip motion expected from an earthquake on the Hosgri fault. The resulting independently estimated ground-motion spectra at the plant site have been compared to the spectra developed by PG&E for the LTSP.

As is discussed in Section 2.5.2.3 of this SSER, the results show that the staff's estimates of both the 50th and 84th percentile horizontal ground-motion spectra at the site is equal to or less than the PG&E spectra at frequencies above 1 Hz, but exceeds the PG&E spectra at frequencies at and below 1 Hz. For vertical ground motion, the staff's 84th percentile vertical spectra exceed the PG&E vertical spectra over the frequency range from 1 to 10 Hz (Figures 2.4 and 2.5). While PG&E has met the requirements of element 3 of the license condition by its reevaluation of ground motion at the site, to fully satisfy element 4 of the license condition, PG&E must demonstrate that the plant structures can withstand these exceedances.

1.3.4 Element 4 of the License Condition

Element 4 of the license condition requires PG&E to assess the significance of the conclusions drawn from elements 1, 2, and 3 using probabilistic and deterministic methods, as necessary, to assess seismic margin adequacy. PG&E has performed a deterministic analysis as well as a PRA and has concluded that the plant seismic margins are adequate.

PG&E performed detailed soil-structure interaction (SSI) analyses to determine the effects of dynamic interaction between the plant structures and the foundation rock underlying the plant on the seismic response of plant structures. The analyses showed that the effects of ground-motion incoherence and embedment of structures (lumped into the "tau effect" in previous studies) reduce the seismic response of some plant structures, but not others. Specifically, incoherence reduces response about 15 percent for the auxiliary building and about 20 percent for the turbine building, but is minimal for the containment shell and internal structures. The NRC staff found, based on its review of PG&E analyses and on analyses conducted by staff consultants, that the PG&E SSI analyses were comprehensive, thorough, and acceptable.

The Diablo Canyon PRA analysis conducted by PG&E included both internal and external events. The objectives of the PRA were to (1) assess the importance of various structures and items of equipment to seismic risk and (2) put the seismic risk in perspective by comparing it to the risk from other external and internal initiators. Risk in this context refers primarily to the estimated core damage frequency (CDF). The PG&E PRA results indicate that the mean overall CDF for Diablo Canyon is estimated to be $2.0E-4/\text{yr}$ (the staff estimate is $4.0E-4/\text{yr}$), which is similar to that of other nuclear plants. The PG&E PRA shows that internal events contribute 63 percent of the total CDF, with seismic events contributing 18 percent and other external events contributing 19 percent. The NRC staff estimates of these values are: internal, 70 percent; seismic, 10 percent; and other external events, 20 percent. A component importance study indicated that the single greatest contributor to seismic risk is failure of the turbine building shear wall (30% of the total seismic CDF), followed by



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loss of 230-kV offsite power (24% of the seismic CDF), and failure of the diesel generator control panel (10% of the seismic CDF).

PG&E performed deterministic comparisons using its LTSP ground-motion estimates and showed that the major plant structures at Diablo Canyon have adequate seismic margins. As a result of a separate reevaluation by the NRC staff of the adequacy of the seismic resistance of masonry walls, PG&E plans to modify all the safety-related masonry walls. The modifications will be determined on the basis of analysis using the Hosgri ground-motion. Selected walls will be evaluated against the LTSP spectra to ensure acceptable margins. The staff has reviewed and approved the modification criteria and the results of PG&E's evaluation of the deterministic margins of selected masonry walls.

As is discussed under element 3, above, the staff's estimates of the horizontal and vertical ground-motion spectra exceed PG&E's estimates by about 15 percent or less over part of the frequency range. PG&E has concluded (Shiffer, 1991i and k) that the plant seismic margins are adequate to accommodate the horizontal and vertical spectral exceedances that result from use of the staff's estimates of horizontal and vertical spectra. The staff has reviewed PG&E's evaluation of the vertical and horizontal exceedances and finds it acceptable, but will require PG&E to perform analyses to confirm its conclusion. Subject to satisfactory completion of analyses confirming that the seismic margins are adequate to accommodate the staff's spectral estimates, the staff concludes that PG&E has met element 4 of the license condition.

In summary, the staff has reviewed PG&E's PRA and deterministic analyses of selected structures and equipment and finds them acceptable. Therefore, subject to satisfactory completion of the analyses necessary to confirm that the spectral exceedances discussed above can be accommodated by plant seismic margins, the staff concludes that PG&E has met element 4 of the license condition.

1.4 Summary of Staff Conclusions

In summary, the staff has reviewed the PG&E submittals relating to the LTSP and, subject to confirmation by PG&E that the plant seismic margins are adequate to accommodate the spectral exceedances discussed under element 4 above, the staff finds that License Condition 2.C.(7) of DPR-80 has been met.

The staff notes that the seismic qualification basis for Diablo Canyon will continue to be the original design basis plus the Hosgri evaluation basis, along with the associated analytical methods, initial conditions, etc. The LTSP has served as a useful check on the adequacy of the seismic margins and has generally confirmed that the margins are acceptable. For future plant design modifications, the staff concludes that LTSP spectra, increased to envelope the exceedances in the vertical and horizontal spectra discussed in Section 2.5.2.3 of this SSER, should be used to verify that the plant high confidence of low probability of failure (HCLPF) values remain acceptable (Section 3.8 of this SSER). PG&E has agreed (Shiffer, 1991i) to review future plant modifications in the light of the findings of the LTSP, and is currently developing an implementation procedure for that purpose.



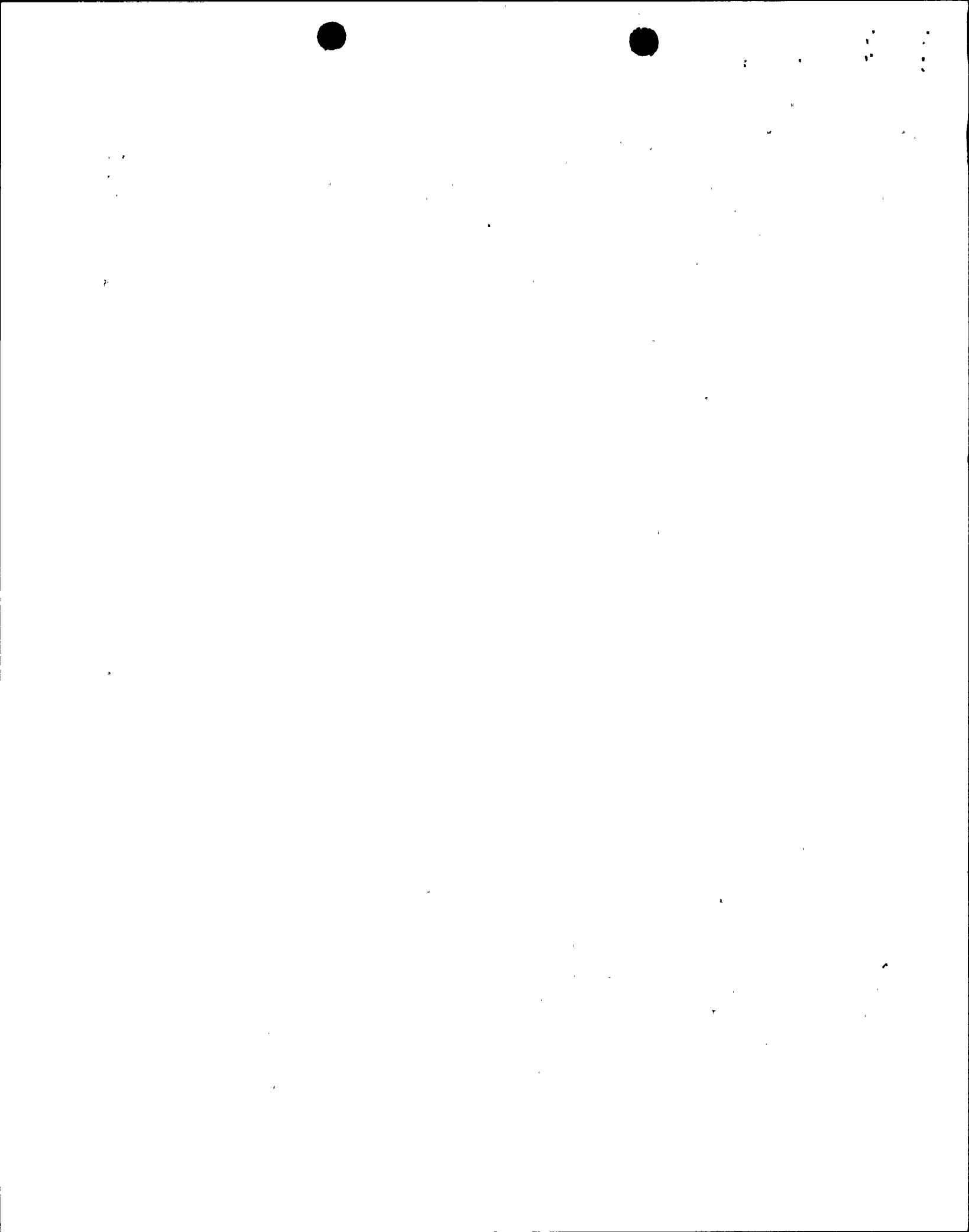
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1.5 NRC Staff Consultants

In conducting its review of the LTSP, the NRC staff engaged a number of consultants. In several instances, the consultants performed independent investigations and analyses. The following is a list of the consultants, their organizational affiliations, the areas they reviewed, and the independent work they performed.

- (1) Keiti Aki, University of Southern California, reviewed the numerical modeling ground-motion studies.
- (2) Ralph J. Archuleta, University of California, Santa Barbara, reviewed the numerical modeling ground motion studies.
- (3) Michael Bohn, Sandia National Laboratory, reviewed the PRA.
- (4) Robert Brown, Thomas Brocher, Jerry Eaton, Steve Lewis, David McCulloch, and David Schwartz, U.S. Geologic Survey (USGS), reviewed geology, geophysics, and tectonics studies (see Appendix C of this SSER) and conducted independent interpretations of the seismic reflection data covering the offshore Santa Maria Basin.
- (5) Kenneth W. Campbell, Dames & Moore (formerly with USGS), reviewed PG&E's empirical ground-motion attenuation studies and conducted independent empirical ground-motion studies.
- (6) Carl J. Costantino, College of the City of New York, reviewed the soil-structure interaction analyses.
- (7) Steven M. Day, San Diego State University, reviewed numerical modeling ground-motion studies.
- (8) George Bozoki, Robert Fitzpatrick, P. Kohut, and M. Sabek, Brookhaven National Laboratory, reviewed the PRA analyses, did independent studies of several systems, and performed importance and sensitivity studies using a reduced plant model.
- (9) James Johnson and M.K. Ravindra, EQE, Inc., reviewed the PRA.
- (10) David B. Slemmons, Douglas Clark, Steve Nitchman, Katheryn Killeen, Barbara Matz, Xiaoyi Zhang, Eutizio Vittori, Richard Schweickert, and Kirk Swanson, University of Nevada, Reno, reviewed PG&E's geology, geophysics, and tectonics characterization studies (see Appendix D of this SSER). These consultants also conducted independent studies, including (1) geological field reconnaissance of the San Simeon area, (2) geological mapping of the Morro Bay, Los Osos, and Edna fault areas, (3) mapping of marine and fluvial terraces of the San Luis-Pismo structural block, (4) mapping, determination of capability, and determination of sense and magnitude of displacement on the Los Osos and Wilmar Avenue faults, (5) mapping and determination of the nature of displacement on the Foxen Canyon fault, (6) determination of the nature of regional tectonic stresses in the Diablo Canyon region, (7) conducting a remote sensing analysis of the Diablo Canyon region, and (8) determination of the cause



and amount of late Quaternary uplift on the Casmalia-Orcutt structural block.

- (11) Anestis S. Veletsos, Rice University, reviewed soil-structure interaction analyses and conducted an independent soil-structure interaction study using a simplified analytical model of the Diablo Canyon power-block structures.

1.6 NRC Staff Contributors

The following members of the NRC staff contributed to the staff review discussed in this SSER:

G. Bagchi
A. Buslik
N. Chokshi
A. Lee
R. McMullen
R. Pichumani
H. Rood
R. Rothman
T. Ryan
P. Sobel



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UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

Enclosure 2

October 18, 1991

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: DIABLO CANYON NUCLEAR POWER PLANT LONG TERM SEISMIC PROGRAM

During the 378th meeting of the Advisory Committee on Reactor Safeguards, October 10-12, 1991, we reviewed the NRC staff's evaluation of the Long Term Seismic Program (LTSP) carried out by the Pacific Gas and Electric Company (licensee) in connection with its Diablo Canyon Nuclear Power Plant, Units 1 and 2. This evaluation is included in Supplement No. 34 to NUREG-0675, the staff's Safety Evaluation Report for the operation of these plants. The background for the LTSP is described below.

The ACRS provided reports on construction permit applications for Diablo Canyon, Unit 1, in December 1967, and for Unit 2 in October 1969. In both instances, no particular concern was expressed about the seismic design basis, which was 0.2g for the Design Earthquake and 0.4g for what was called the Double Design Earthquake.

In 1971, the Hosgri Fault was discovered and the seismic design bases were reviewed and revised over the next few years. During this period, the ACRS and its consultants in the areas of geology, seismology, and earthquake engineering were involved to a significant extent in the efforts of the staff and the licensee to arrive at new seismic design bases. During this period, the ACRS held ten subcommittee meetings, seven of which related to seismic matters. Three of these seven meetings were held in San Luis Obispo, California, near the site; two in Los Angeles, California; and two in Washington, D.C.

The ACRS review of the operating license application for Diablo Canyon was completed with two subcommittee meetings and a meeting of the full ACRS in June and July 1978. The ACRS report endorsing an operating license was issued on July 14, 1978. This report included extensive discussion of the revised seismic design bases for the plant and reasons for finding them acceptable, and concluded with the following statement:

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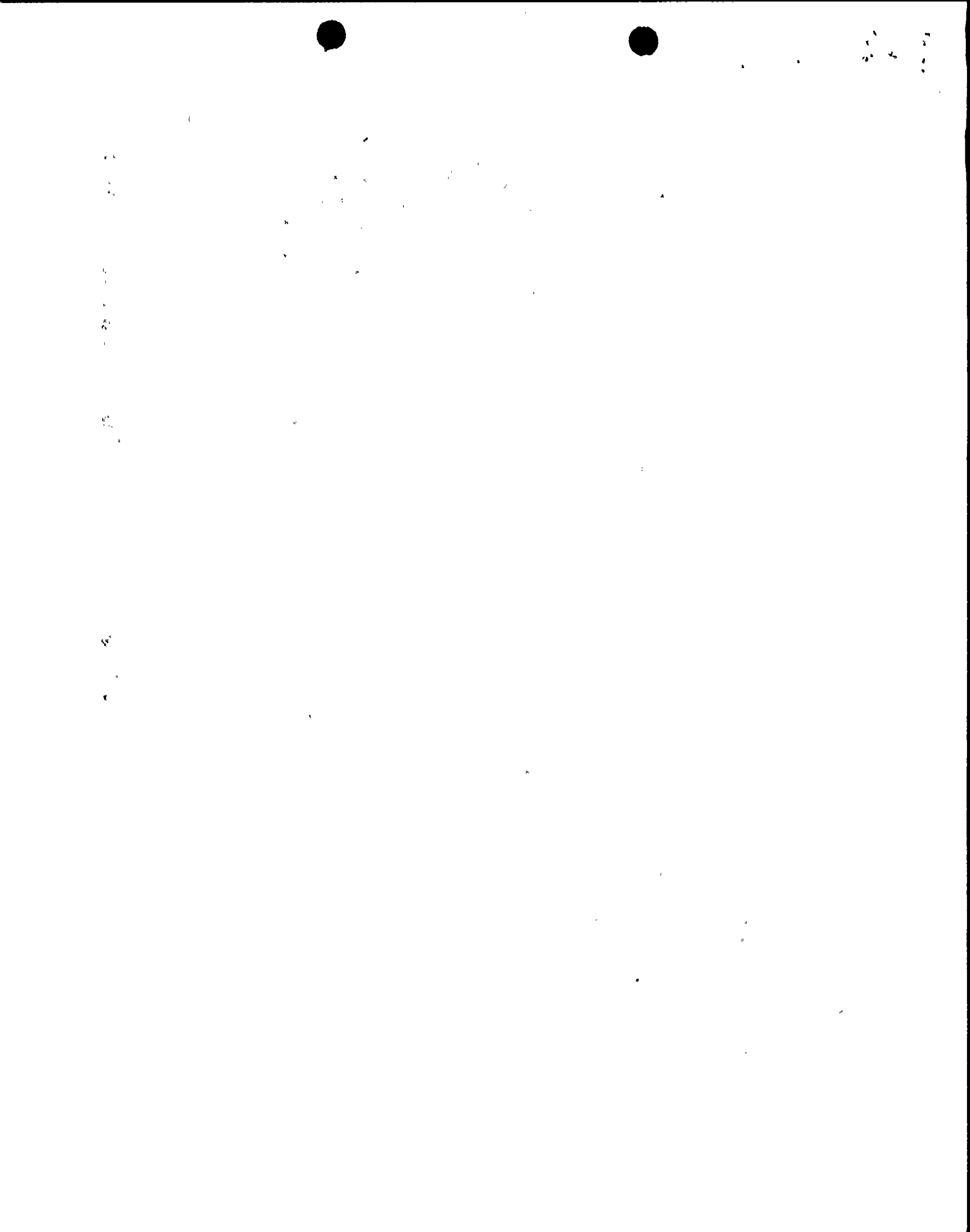
"The ACRS notes that, for distances less than 10 km from the earthquake source, there are currently no strong motion data for shocks larger than magnitude 6 and few reliable data for shocks of magnitude 5 and 6. Also, the theory and analyses of earthquake and seismic wave generation, of seismic wave transmission and attenuation, and of soil-structure interaction are in a state of active development. The Committee recommends that the seismic design of Diablo Canyon be reevaluated in about ten years taking into account applicable new information."

As a result of this recommendation by the ACRS, the NRC included in the operating license for Diablo Canyon a license condition requiring what became known as the Long Term Seismic Program. The Committee reviewed this license condition at subcommittee and full committee meetings in May and June 1984, and indicated its agreement in a report dated June 20, 1984. The operating license was issued in November of that same year.

The licensee and the NRC staff spent the next year developing and reviewing a plan for the conduct of the LTSP. The ACRS reviewed the proposed plan and indicated its agreement in a report dated July 17, 1985. The LTSP was begun in July 1985 and completed in July 1988 -- three years as required by the license condition. During that period, the Committee reviewed progress on the program at subcommittee meetings in November 1986 and February 1988. In addition, the Committee's consultants in the areas of geology and seismology attended numerous meetings at which the results from the program were presented and discussed by the licensee, the NRC staff, and other interested and knowledgeable persons.

The staff's Safety Evaluation Report covering the LTSP was issued in June 1991, after a substantial period of review of the licensee's report and requests for, and submittal of, additional information. Our final review involved a subcommittee meeting in San Luis Obispo on September 16-17, 1991, and review by the full ACRS during its 378th meeting.

At our subcommittee meeting on September 16, 1991, several members of the public expressed the view that the United States Geological Survey (USGS) should be retained by the NRC to perform an independent seismic study of the Diablo Canyon area. We see no need for such a study. The USGS was retained by the staff as a consultant on geologic and seismologic matters, as were other competent consultants. During progress in the program and in our review of the final report and safety evaluation, we, with the help of our consultants in these areas, have given special attention to the activities of the licensee and the staff relating to geology and seismology. We are satisfied that these programs have been carried out in a competent and professional manner. Those geologic and




October 18, 1991

seismologic characteristics of the area that are significant to the seismic safety of the plant are not at issue among the large number of experts and consultants associated with the licensee, the staff, and the ACRS.

We agree with the staff's conclusion that, subject to resolution of some minor confirmatory items, the License Condition has been met. We believe further that the seismic margins for the plant are adequate and quite comparable to those for other plants in the United States. The results of the probabilistic risk assessment show no significant seismic vulnerabilities. We continue to believe that the Diablo Canyon Nuclear Power Plant can be operated without undue risk to the health and safety of the public.

Mr. James C. Carroll did not participate in the Committee's deliberations regarding this matter.

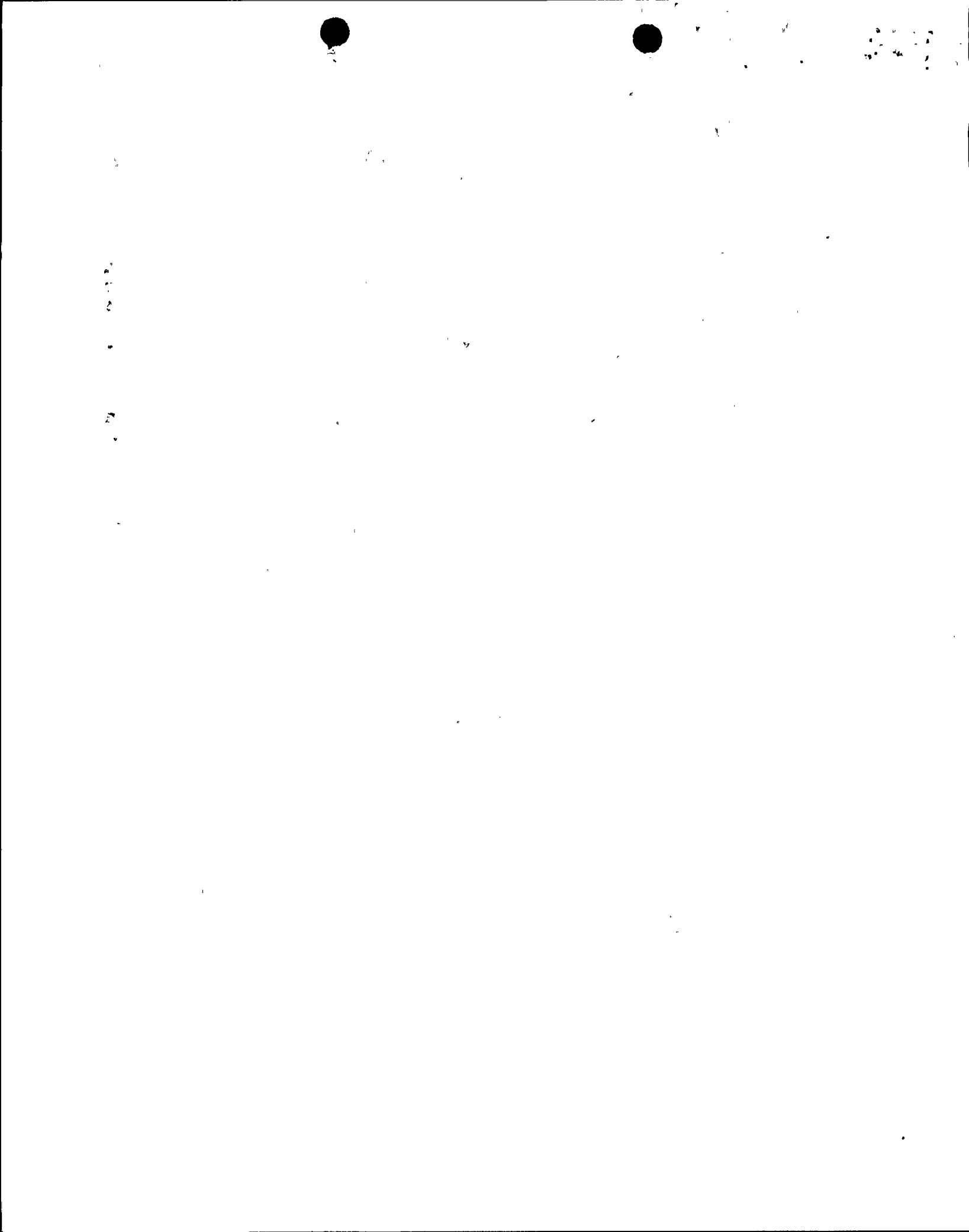
Sincerely,



David A. Ward
Chairman

References:

1. U.S. Nuclear Regulatory Commission, NUREG-0675, "Safety Evaluation Report Related to the Operation of Diablo Canyon Nuclear Power Plant, Units 1 and 2, Supplement 34," June 1991
2. Pacific Gas and Electric Company, "Final Report of the Diablo Canyon Long Term Seismic Program," July 1988, and addenda through May 29, 1991



Merley
cy. J. Martin, RV

OFFICE OF THE SECRETARY
DOCKETING AND SERVICE BRANCH CONTROL TICKET

TICKET NUMBER: DSB-91-148

UTILITY/	DIABLO
FACILITY:	CANYON

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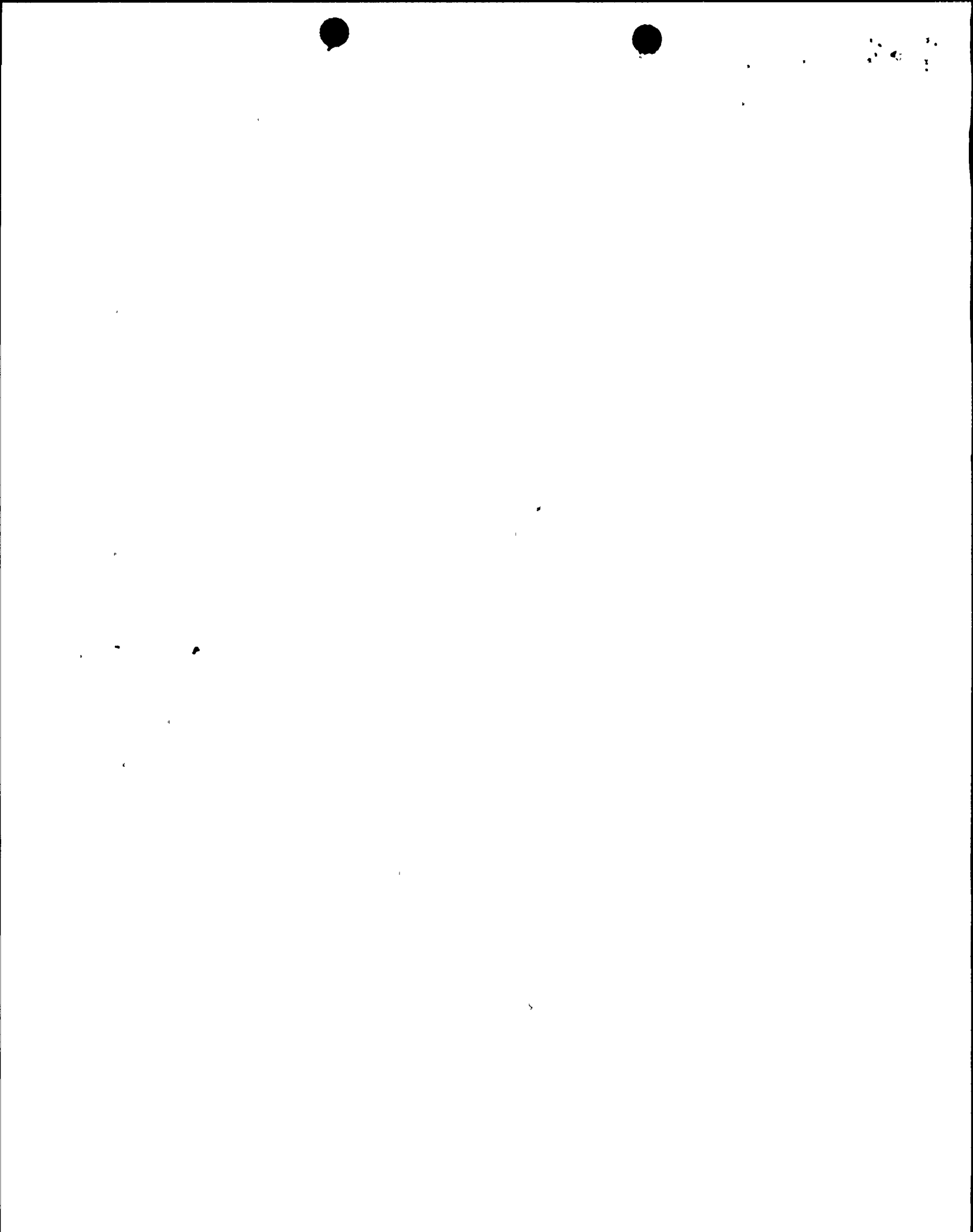
DOCUMENT TYPE: ADJUDICATORY
DOCUMENT TITLE: PETITION AND PUBLIC COMMENT

AUTHOR: ZAMEK & BECCIC AFFILIATION:
REPRESENTING:
RECEIPIENT: COMMISSION
SUBJECT:

DOCUMENT DATE: 09/15/91 DOCKET DATE: / /
CROSS-REFERENCE:

ACTION OFFICE:	EDO	ACTION: APPROPRIATE	ACTION DUE:	/ /
COMMISSION ACTION EXPIRATION DATE:				/ /

DISTRIBUTION: COMM, CHILK, OGC, CAA, EDO
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SPECIAL HANDLING: DSB NUMBER:





UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

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September 19, 1991

OFFICE OF SECRETARY
DOCKETING & SERVICES
BRANCH

MEMORANDUM FOR: Samuel J. Chilk, Secretary

FROM: *R. F. Fraley*
R. F. Fraley, Executive Director

SUBJECT: DIABLO CANYON NUCLEAR PLANT - PETITION AND PUBLIC COMMENT

During the ACRS Subcommittee meeting on the Diablo Canyon Nuclear Plant on September 16-17, 1991 at San Luis Obispo, the attached petition and letter were received from Ms. Jill Zamek and Mr. John Beccic, respectively.

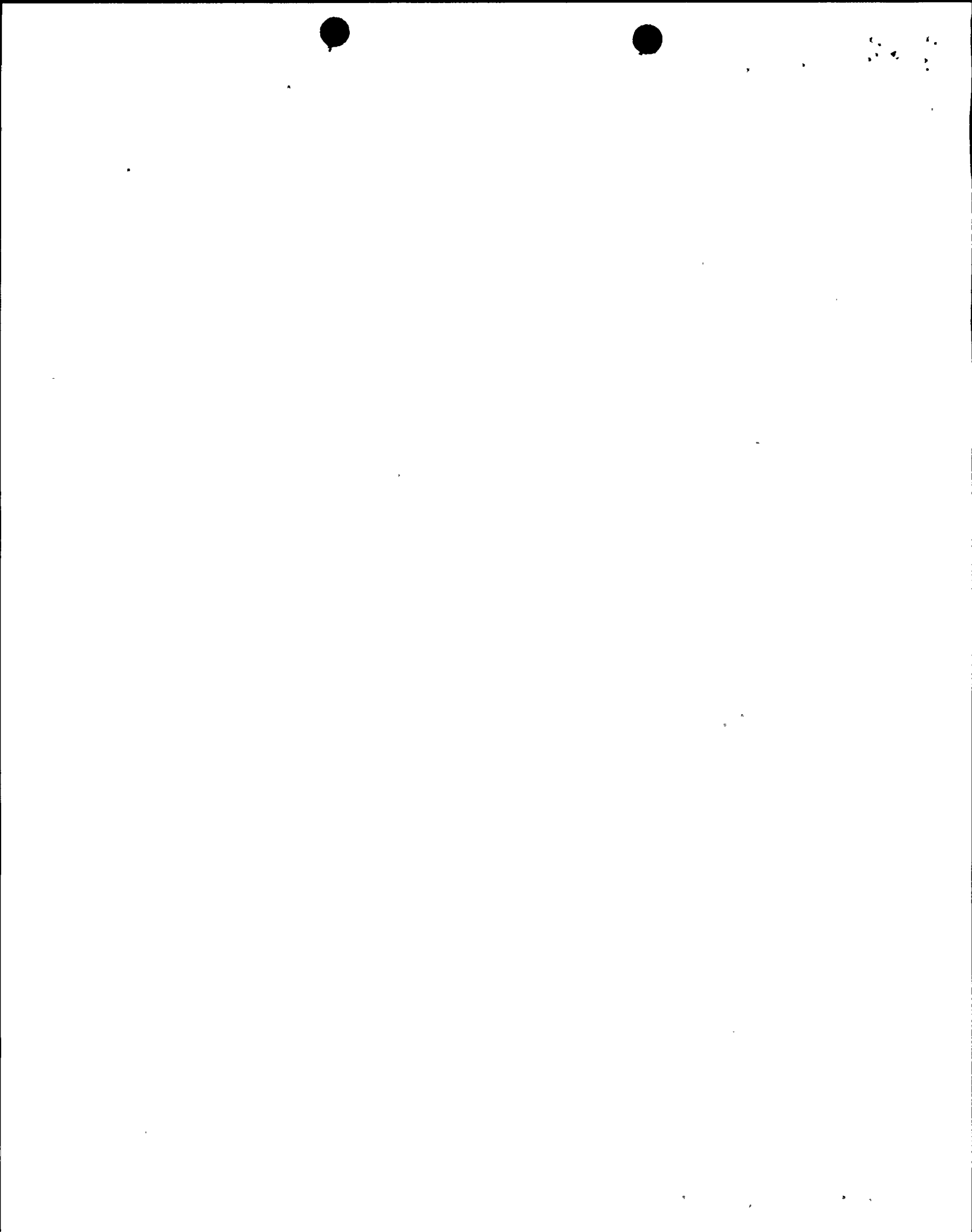
Ms. Zamek did appear at our meeting as a member of the San Luis Obispo Mothers for Peace, but she did not indicate if the petition was being submitted as a representative of the San Luis Obispo Mothers for Peace or as a private citizen.

Since both the petition and the letter request action by the Commission, I am forwarding them to you for appropriate action.

Attachments:

1. Petition from Residents of San Luis Obispo County, received September 16, 1991
2. Letter from Mr. John Beccic dated September 15, 1991

920227013



Sept. 15, 1991

Dear NRC Commissioners,

Since I cannot attend the hearings because they are being held during work hours I wanted to put some comments in writing to be part of the public record.

First of all I want to voice my displeasure that the seismic study was done by P.G.&E. This is the same company that for 6 years kept the information of the Horgri Fault's discovery from the public. I don't feel they can be trusted to be impartial on this matter. An Earthquake study should be done by an independent scientific organization such as the United States Geological Survey so we know the information we receive is accurate. We folks who live with the danger of this plant being next to an active earthquake fault deserve this consideration.

I'd like to think the N.R.C. is truly the Nuclear Regulatory Commission and not the Nuclear Rubberstamp Commission but I suppose your actions on this matter will tell us which role you choose.

Thank You,

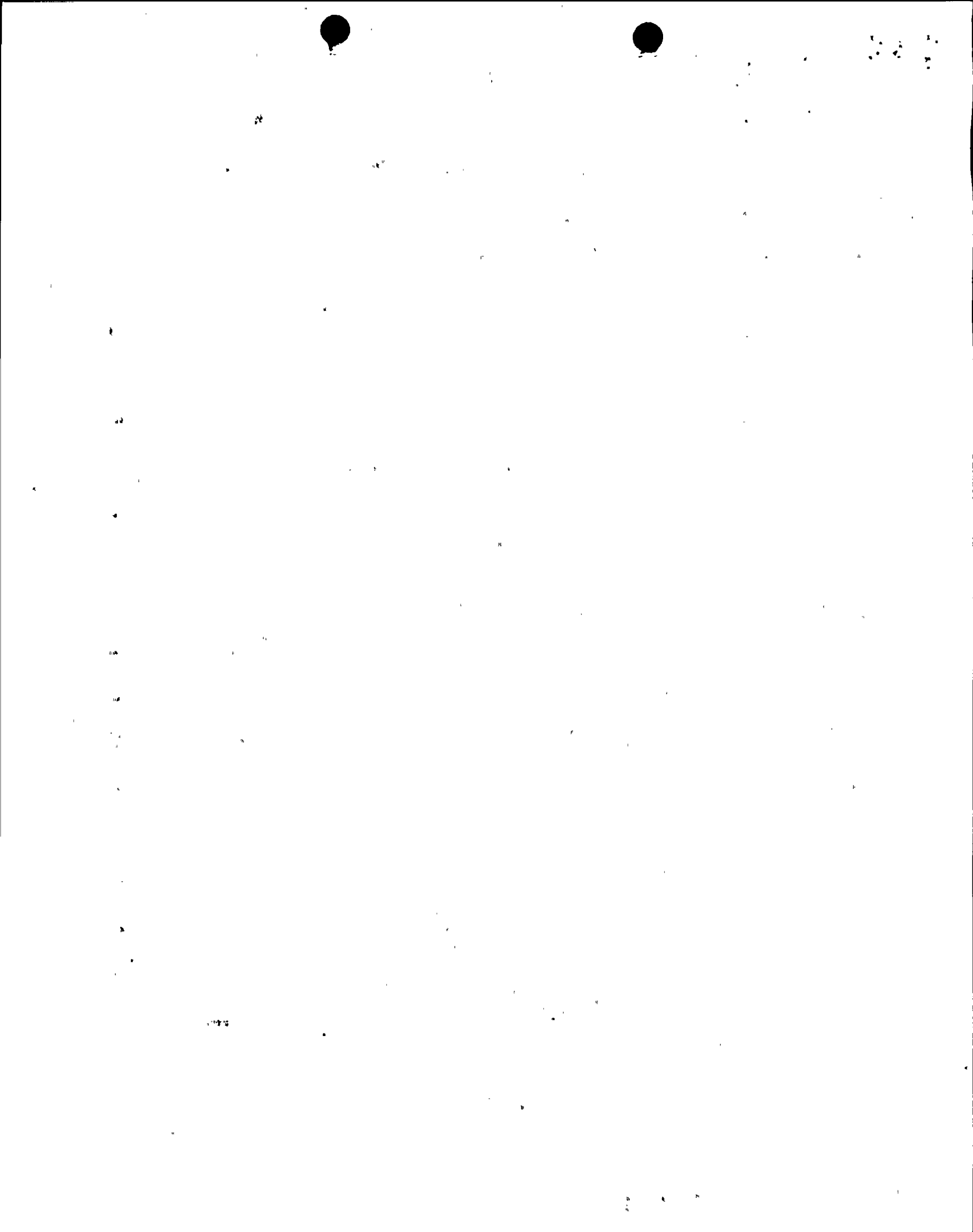
John Beccia

John Beccia

Star Rte. Box 231

Starbuck, OR. 97143

~~9202270126~~



As a resident of San Luis Obispo County living in the Diablo Canyon Nuclear Plant's evacuation zone, I request the Nuclear Regulatory Commission to immediately implement a complete and independent seismic study of the Diablo Canyon area by the United States Geological Survey. This independent study should be paid for, but not influenced by, Pacific Gas and Electric Company.

Received from J. Zaman
 01-91 Embassy Suites
 Hotel
 to CPS
 accepted by
 [Signature]

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Ramona BENSON #2 Box 440 SLO

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Paul Chretien 2005 10th St Los Osos

Sacha Polston 2005 10th St. LOS OSOS CA. 93402

Penny Paine 2715 #C 4012 Los Osos 93402

ISAAC HORTON 1911 12th St Los Osos 93402

Nan Hamilton 219 Le Point Arroyo Grande 93420

PAT VEESACK 1570 HANSEN SLO 93401

John Decherty 828 Lake Sherwood Thousand Oaks 91361

Frank Garcia 1700 SAN RAMON RD ATASCADERO CA 93422

Inda Powell-McMillon Gilles Canyon Road Chalone CA 93431

Elizabeth Diaz de Leon 1135 D SAN ANTONIO SO 97101

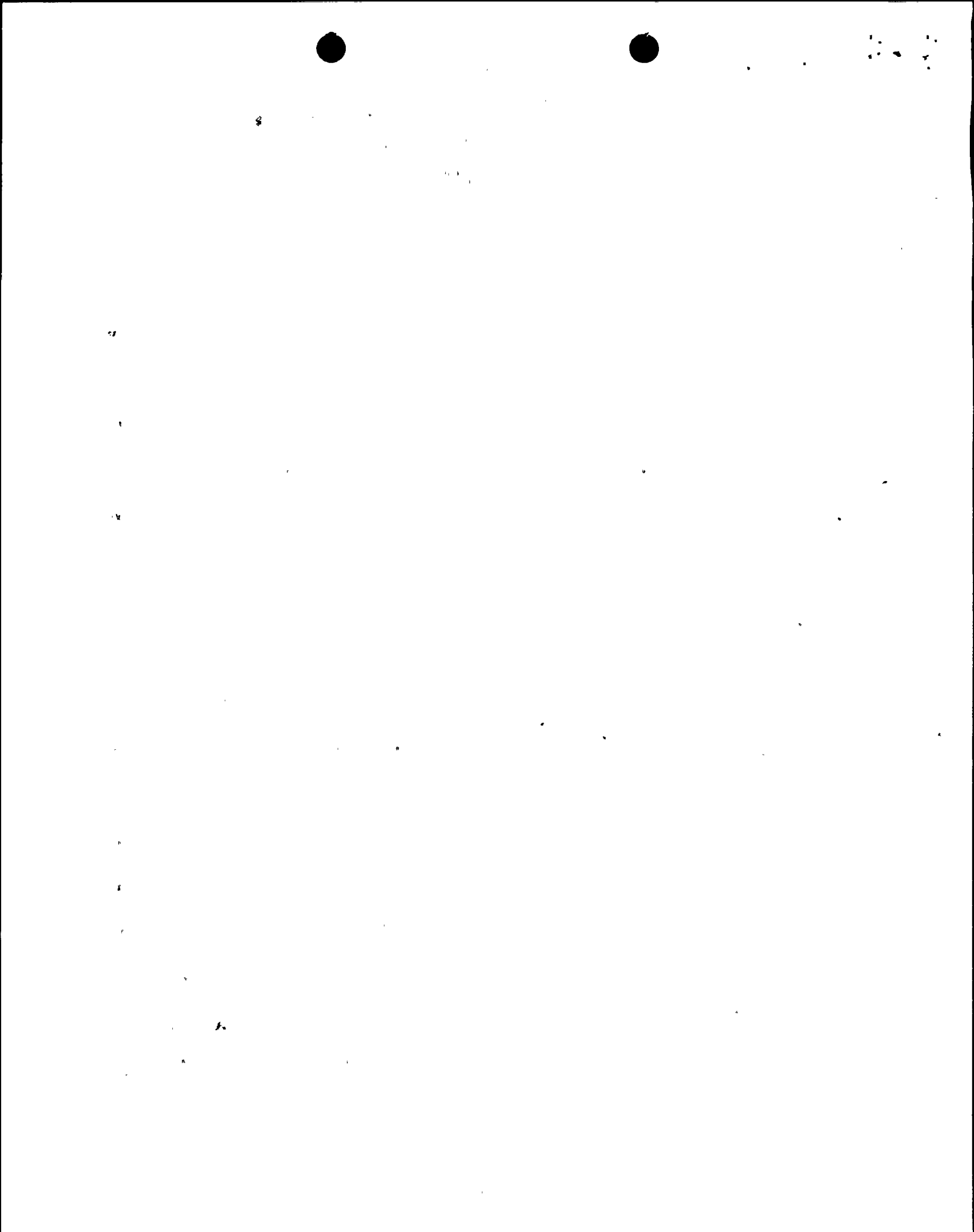
R. Malpede 212 Olive St. Santa Cruz 95060

Carl Jank 850 Church SLO 93401

Dennis Combs 1432 Toro St SLO. 93401

Kathy Combs 1432 Toro St. SLO 93401

John Bean 226 N Murphy Ave Sunnyvale 94086



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NAME

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Dana Wright	752 Islay, SLO, Cal 93401
Charles Wright	1689 Crestview Cir. SLO CA 93401
Condra Lee Stets	3019 Bahia Ct SLO CA 93401
Caroline Stets	" " " " " " " "
M.K. S.	120 HI MOUNTAIN RD ARROYO GRANDES

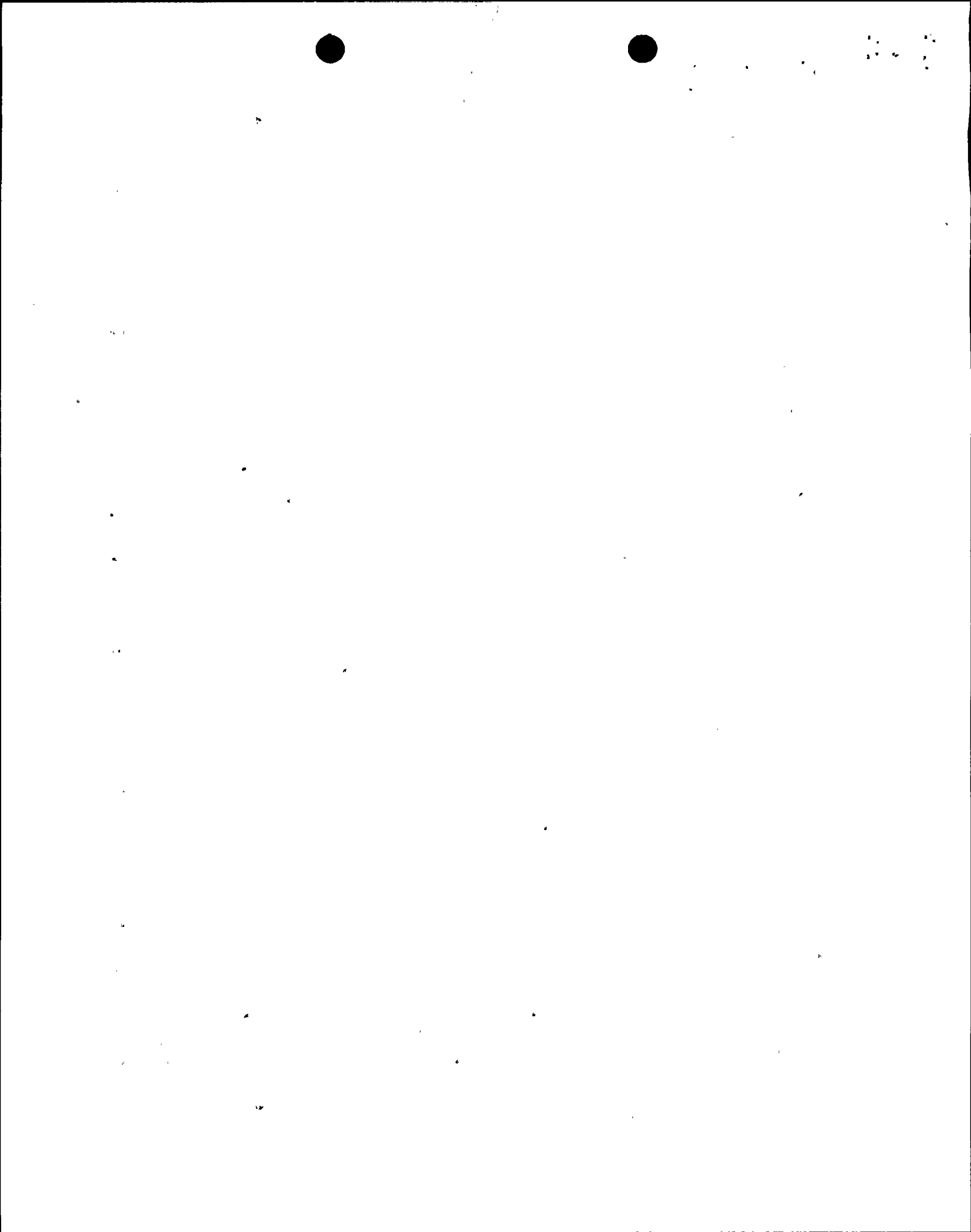


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Kathy Pleyer 1023 N. Thornburg, Santa Maria, CA 93454
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Mangayee Joshi 337 7th Terrace, SLO 93405
Michael A. Yushman 337 N. Terrace, SLO, 93405
Nancy Culver 192 Luneta SLO 93405
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Stephanie Pahl 183 San Jose ct. SLO 93405
Kathy Jinner 1077 McCollum St SLO 93405
Laura Presley 644 Jeffrey Dr SLO 93405
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Julia McGonagill 485 Arbutus, Morro Bay, CA 93442
Ann Moran 1570 Berwick Dr Cambria, CA 93428
Cileen Macklin Musial 536 Creston Paso Robles 93446
Rosemary Donnell PO Box 870 Morro Bay 93443



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NAME

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Hilary McQuie 3605 23rd St. SF, CA 94110
Robin Kossell 3605-23rd St. SF CA 94110
DAWN BLACK-FOX 1516 F ROSE SANTA MARIA, 93459
BILL SPENCERSON P.O. Box 2448 WEAVERVILLE CA 96093
Patricia P. Miller 1962 Hope St. ALO 93405
Joseph Aschew



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Rosalyn Clifton 302 Vista Del Mar Shell Beach 93446

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~~St. Hill~~ 1911 ASPEN LOS OSOS

JOEL PANCAST 1911 ASPEN LOS OSOS

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Bill W. Morales P.O. Bx 675 SLO

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John J. DiLillo 21 Belvedere St San Francisco 94117

New Mc Mullin 1000 Park St New Noble 93446



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Sheila J. Baker " " " "

CRAIG STEFFENS POB 15814 SLO 93406

Lisa Chavez 1391 Vista Del Lago SLO CA 93405



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Meticia Rorty 5120 Bridgeport Rd, S.L.O., CA 93401
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Kidi Lewis-Miller 472 Mitchell Dr. San Luis Obispo CA 93401
Alex Magan 1806 Huxiana Dr. SLO CA 93405



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Geert [unclear] 939 Noyes Rd. AG CA 93421

Gene [unclear] P.O. Box 36 Arroyo Grande, CA 93421

Clara [unclear] 1992 Camino S.C.O. CA 93401

Wanda Michalenko, 7368 Hollister #1, Galleta 93117

Susan Nielsen 259A Harbor Pismo Beach, CA 93449

Raymond MacKenzie 264 N. 8th St. #C GROVER CITY CA 93433

Marcelle Martin P.O. Box 15347 SLO CA 93406

Lite Comp 1183 El Camino Real # D-5, Arroyo Grande, CA 93424

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Kwee Eng Thomas 830 Wadsworth, P.B. CA 93449

Eva Uran 4320 S. Higuera #6, San Luis Obispo CA 93401

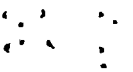
Shirley MEDNIC 2329 Los Arboles Way Los Osos 93402

~~Shirley Mednic~~ 2329 Los Arboles Way Los Osos 93402

Bonnie Glendenning 1525 Ramona Grover City 93433

Van Ahrends 1525 Ramona Grover City 93433

G. Compton 5330 Enseñada ATAS 93422



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Hub Jantz P.O. Box 7010, HAZELTON, CA 93429
Lisen Bonnier 6015 Los Osos Valley Rd CA 93705
BOB McAFEE 1996 9th St. LOS OSOS, CA 93402
Caminu Tripod 521 E. Cherry Arroyo Grande CA 93420
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Dorene Garvin 321 "E" St #3 Cayucos CA 93430
Kathy DiPeri 46 Prado Rd SLO, CA. 93401
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Jeff Scott 573 Winterhaven Arroyo Grande, ca 93420
Katie Wheeler 285 Hacienda Drive Cayucos Ca, 9.
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-Jack Artusio 1604 morro #12 SLO CA 93401
Margaret Evans 1673 9th Lo. CA. 93402



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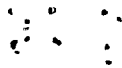
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Marilyn Rossa 546 Kings M.B.
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Elden T. Boothe P.O. Box 469 Los Olivos, CA 93441
Dorothy Bagley Booth 2604 Gold Cove, Port Huenehue, CA 93041
Bob Arell 370 Joly St. S.L.O. 93401
SUSAN BIRCH 2829 See Canyon RD SLO CA 93405
JENNIFER BIRCH 2829 See Cyn Rd SLO CA 93405
Kathy 8888 Two Creek Atlas Calif 93422
Bally Craig 8888 Two Creek Atlas, Ca. 93422
M. J. Hoggan Star Kit Box 238 Santa Margarita Ca 93453
Mary P. Cooper Star Kit Box 238 Santa Margarita Ca 93453
Lizbeth Hanley 1250 Tiffany Rd SLO CA 93405



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 Jane Swanson 475 Squire Canyon Rd. ^{San Luis Obispo} CA 93401
 Judi Cascardi 1214 Fernwood SLO 93401
 Andy Carter 1214 Fernwood Dr. SLO 93401
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 Lauri Elliott 1147 Kit Way Santa Maria 93455
 Diane Stallard 1068 Pacific St SLO 93401
 Mary Stallard 239 Piney Way M.B. 93442
 Elsie P. Riolandi 5585 Oxtoven Court 93432
 Jacquelyn White 3303 Barona Ct SLO 93401
 Hailes Hafley 2145 Cypress St, San Luis Obispo, 93401
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Quadrin Grell 7092 Halcyon Ca 93421



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~~John Rider 1118 Flora Rd. CA 93420~~
John Rider 1118 Flora Rd A.G. Ca. 93420
~~Doc Proff 1111 FLORA ROAD. 93420~~
~~J. Fisher 428 Tanner A.G. Ca. 93420~~
Ann Sawyer 427 Tanner AG Ca 93420
John W. Miller 477 Tanner Ln. A.G. Ca. 93420



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JOE BIESEK 1829 See Lyn, SLO CA 93405

NEAL SISTER 2512 LAWTON SLO CA 93401

SARA WEST 1420 Palm, SLO, CA 93401

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

January 10, 1992

Mr. Richard P. Grill
19305 Frenchton Place
Gaithersburg, Maryland 20879

Dear Mr. Grill:

This letter is to acknowledge receipt of your petition dated November 25, 1991, in which you request the Executive Director for Operations to institute a proceeding, pursuant to 10 CFR 2.202, "to suspend the operating license of any nuclear power plant licensed by the Commission whose license is not supported by: a) a thorough analysis of the effects of lightning induced and other electrical transients on nuclear safety related electrical or electronic systems; b) a determination of potential accident scenarios and their consequences resulting from electrical and electronic system failures; c) the consequences to both the plant and to public health and safety from such accidents; d) the specific design features incorporated to prevent system failures from electrical transients; e) the Technical Specifications and maintenance features to assure safe operability of these design features and the systems they protect and f) a thorough licensing review of the above by competent NRC staff."

You assert, as basis for this request, that the safety-related control and monitoring systems in nuclear power plants are complex and sophisticated with designs based on transistors and solid-state integrated logic systems which can be disrupted by "small fluctuations of current," and that the NRC has not critically evaluated the effect of electrical transients induced by lightning, switching surges, or other sources on the electrical and electronic monitoring and control designs of any "single U.S. nuclear power plant."

You further state that on August 16, 1991, you filed a petition for rulemaking on the same subject. The reasons you state for now seeking action pursuant to Section 2.206 are that you have had no acknowledgement of your petition for rulemaking; that recent lightning-related and electric-surge incidents have compromised NRC and DOE facilities, increasing your sense of urgency; and that the procedures available to resolve actions proposed under Section 2.206 are more rapid.

The Office of Nuclear Reactor Regulation (NRR) has reviewed your petition and concluded that it does not provide any basis for immediate suspension of the operating licenses of any NRC-licensed nuclear power plants. Our basis for this position is that your concerns have not identified any new information which has not already been addressed by licensees and the staff during the licensing process, or which we were not already aware of and are assessing in our ongoing reviews of operating event reports. Operating events at nuclear power plants involving lightning or switching surges have not resulted in significant damage to safety-related equipment, or any loss of safety function. Therefore, it is our conclusion that these phenomena do not pose a significant safety concern warranting the immediate suspension of the operating licenses of nuclear power plants.

NRC FILE CENTER COPY

Handwritten initials and marks, including "QFOL" and "111".

