FROM	CONTROL NUMBER	FILE LOCATION
Stanley H. Mendes Santa Barbara, Calif.	6575	
	DATE OF DOCUMENT 1/9/74	ACTION COMPLETION DEADLINE 1/25/74
TO	ACTION PROCESSING DATES	PREPARE FOR SIGNATURE OF:
C hairman	Acknowledged _____ Interim Reply _____ Final _____	_____ Chairman _____ Director of Regulation X CGC

DESCRIPTION Ltr ☒ Original ☐ Copy ☐ Other

Relates experiences in attempting to express concern as to appropriateness of certain basic earthquake design criteria for Diablo Canyon at public hearings in May 1972 and again when the EIS was submitted for consideration in Jan. 1973

Encl: Affidavid & Position Paper

REMARKS

Send 3 cys of reply to the SECY mail facility (74-2944)

REFERRED TO	DATE
Shapar f/action	1/17/74

IS NOTIFICATION TO THE JCAE RECOMMENDED? _____ _____

Cys:
Giambusso
Docket Files) 50-275
PDR -323
LPDR (2)

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DIRECTOR OF REGULATION
COMMUNICATIONS CONTROL

Form HQ-32 (1-73)
USAEC

HQ 200a (11-73)

NO. 74-2944 LOGGING DATE Jan. 15, 1974

AEC SECRETARIAT

TO: ☐ COMMISSIONER _____ DATE: 1/15/74

☐ GEN. MANAGER ☐ GEN. COUNSEL ☐ INFO. SERVICES

☒ DIR. REGULATION ☐ PLAN. & ANAL. ☐ SECRETARY

☐ _____

INCOMING FROM: Stanley Y. Mendes
1226 1/2 State St., Suite 1
Santa Barbara, Calif.

DATE: January 9, 1974

SUBJECT: Pacific Gas & Elec. Co. Diablo Canyon Nuclear Power Plant Facilities affidavit and position paper

☐ PREPARE REPLY FOR SIGNATURE OF:

- ☐ CHAIRMAN
- ☐ COMMISSIONER
- ☐ GM, DR, GC, PA, IS, SECY
- ☐ SIGNATURE BLOCK OMITTED

☐ PLEASE RETURN ORIGINAL WITH RESPONSE

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- ☒ SECY MAIL FACILITY (3)
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- ☐ COMMISSIONERS
- ☐ SECRETARY

☐ FOR APPROPRIATE ACTION

☐ FOR INFORMATION

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REMARKS: _____

FOR THE COMMISSION: _____

WHEN SEPARATED FROM ENCLOSURES HANDLE THIS DOCUMENT AS _____

DR-6575

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STANLEY H. MENDES
STRUCTURAL ENGINEER
1226½ STATE ST. SUITE 1
SANTA BARBARA, CALIF. 93101

PHONE (805) 962-9870

January 9, 1974

Dr. Dixy Lee Ray, Chairman
U. S. Atomic Energy Commission
Washington, D. C. 20545

Re: Pacific Gas & Electric Company
Diablo Canyon Nuclear Power
Plant Facilities

Dear Dr. Ray:

This letter and accompanying Affidavit and Position Paper is directed to you at the suggestion of my friend, Dr. William Aron, with N.O.A.A. I recently discussed with Bill the several very frustrating experiences I have had while attempting to express my concern as to the appropriateness of certain of the basic earthquake design criteria for the facilities at Diablo Canyon. Based upon published design criteria, it is extremely questionable how satisfactorily the facilities will respond to the effects of earthquake forces.

I serve as consultant to Scenic Shoreline Preservation Conference, Inc., an Intervener in the various hearings which have been held regarding the Diablo Canyon facilities. On or about May 20, 1972, public hearings were held at Cuesta College, San Luis Obispo County, California, to determine whether construction should be allowed to proceed pending preparation of the Environmental Impact Statement. The Hearing Officer informed Counsel for Scenic Shoreline Preservation Conference, Inc., that my testimony would be permitted. The very next day, he advised us that he must withdraw his earlier ruling, because the Atomic Energy Commission had specifically instructed that the hearing be closed to the introduction of matters relating to earthquake safety. Why, and on what authority was this action taken? It is inconceivable that any fair-minded person can conclude that earthquakes do not have a very substantial impact on our environment.

The enclosed Affidavit and Position Paper was prepared for presentation at the Cuesta College hearings of May 20, 1972. When the draft Environmental Impact Statement of December, 1972, was issued, this previously prepared statement was submitted for consideration in January, 1973. Once again, we were refused the opportunity to have my opinions become a matter of public record. Why?

Rec'd Dir. Div. Orig
Date 1/16/74
Time 11:35

DE 5575

It is quite obvious from past experiences that considerable effort has been expended on the part of the Atomic Energy Commission and Staff and Pacific Gas and Electric Company to exclude my testimony from public hearings. There are other means available to bring my concerns out into the open. No matter how time consuming, costly and personally distasteful these other means may be, I am reconciled to use them if a satisfactory response is not forthcoming.

Please look into this situation very carefully. I would be pleased to furnish any additional information you may require.

Very sincerely yours,

Stanley H Mendes

Stanley H. Mendes

SHM:pm

Enclosures

cc: Dr. William Aron

AFFIDAVIT OF STANLEY H. MENDES

STATE OF CALIFORNIA

COUNTY OF SANTA BARBARA

STANLEY H. MENDES being duly sworn, deposes and says This affidavit is in support of the request by Scenic Shoreline Preservation Conference, Inc., to be an Intervener in the hearings on the Environmental Impact Statement prepared by the U. S. Atomic Energy Commission, Directorate of Licensing for the Diablo Canyon Nuclear Power Plant, Units I and 2 of the Pacific Gas and Electric Company.

I am a registered Civil Engineer, #8223, and Structural Engineer, #709, in the State of California. I received a Bachelor of Science degree in Civil Engineering from California Institute of Technology in 1947.

All of my twenty-six years of experience has been in the design and supervision of construction for buildings and related structures. Much of the work which I have done has been with buildings of Type I construction. After eight and one-half years as a structural designer for Donald F. Shugart, Structural Engineer, the partnership of Shugart and Mendes was formed in 1955 with offices in Santa Barbara. I have had my own offices since 1959. In addition to my consulting engineering office, I supervised the A. F. Janes Testing Laboratories, Inc., of Santa Barbara, for more than two years.

ACTIVITIES:

Structural Engineers Association of Southern California - Member

American Society of Civil Engineers - Fellow

Santa Barbara Engineers Club - Past President

National Panel of Arbitrators of the American Arbitration Assn.

Santa Barbara YMCA - Board of Directors (13 years)

Rotary Club (17 years)

Citizens Planning Association

Santa Barbara County Committee for School District Organization

Santa Barbara City Water Commission - Former Member (14 years)

Lecturer - Calif. Poly College, San Luis Obispo 1967-8

My office has furnished consulting structural engineering services for numerous building projects, principally schools, churches, hospitals, offices, etc. We have designed buildings for University of California at Santa Barbara, Cal Poly San Luis Obispo, as well as many public buildings for the City and County of Santa Barbara. Construction costs for completed projects are in excess of $45,000,000, principally in Santa Barbara County. We have a background of experience which includes almost all of the present day uses of steel, concrete and timber. We have designed foundation systems utilizing steel piles, caissons, mats, etc. Investigations of existing structures, ranging from residential and school buildings to multi-story commercial buildings have been made.

Present projects include investigations of about fifty existing buildings for potential earthquake hazards. These buildings range from one-story wood frame to eight-story reinforced concrete structures.

STANLEY H. MENDES
STRUCTURAL ENGINEER
1226½ STATE ST. SUITE 1
SANTA BARBARA, CALIF. 93104

PHONE (805) 962-9870

January 23, 1973

This position paper is to set forth what I believe are substantial questions regarding the adequacy of the Diablo Canyon Nuclear Power Plant facilities to withstand the effects of earthquakes. The draft Environmental Statement specifically omits any reference whatsoever to the possible adverse effects on the facilities in the event that the buildings, piping, utilities, etc., fail or are damaged during seismic disturbances.

It is my opinion and position that:

1. The citizens of San Luis Obispo City and County and the State of California should be fully informed as to the risks which accompany construction and operation of a nuclear power facility in this state. If the people of California are <u>fully informed</u> and are <u>given a choice</u>, they would not willingly and knowingly accept the risks.

2. Unacceptable risks very likely exist whenever nuclear power facilities are subjected to the forces and effects of earthquakes which have been occurring in the western portion of the United States, particularly California, for hundreds of millions of years.

3. The present State of the Art in the fields of geology, soils engineering, seismology and engineering very likely will not permit the design and construction of nuclear power facilities without substantial risk to the health, safety, and welfare of the people of the State of California.

4. Open and candid discussions should take place among interested and informed persons in the fields of geology, soils engineering, seismology and engineering and opinions solicited regarding:

   a) the State of the Art,

   b) whether the State of the Art will permit proper design and construction of nuclear power facilities which are subjected to the forces and effects of earthquakes,

   c) the degree of risk which accompanies design and construction of nuclear power facilities which are subjected to the forces and effects of earthquakes,

   d) the consequences of a nuclear disaster which may accompany natural disasters such as earthquakes.

5. A Conference should be held to solicit open and candid discussion among interested and informed professionals in order to establish the thinking of the professions. Said Conference should be under the sponsorship and guidance of an unbiased institution, organization, or public entity. Additional Conferences should be held as may be necessary to reach a consensus.

If the consensus of interested and informed geologists, soils engineers, seismologists and engineers can assure the people of California that a nuclear incident will not occur as a result of the forces and effects of earthquakes, then all is well and good. If such assurances are not forthcoming, then the construction of nuclear power facilities should be halted. In addition, all presently operating nuclear facilities should be retired from service until such time as proper assurances can be given.

3.1 Donald E. Hudson, Professor of Mechanical Engineering and Applied Mechanics, California Institute of Technology, Pasadena, California, contributed Chapter 6 of Reference 1, entitled, "Ground Motion Measurements". He wrote as follows:

"6.1 INTRODUCTION

"Any study of earthquake engineering that is to have a sound scientific foundation must be based on accurate knowledge of the motions of the ground during destructive earthquakes. Such knowledge can be obtained only by actual measurements in the epicentral regions of strong earthquakes.

"The number of destructive earthquakes for which such measurements are available unfortunately is very small. It is perhaps not generally realized how slender our stock of accurate information really is in this respect. For example, not a single measurement of strong ground motion was obtained for any of the following recent destructive earthquakes: Mexico (1957), Chile (1960), Agadir (1960), Iran (1962), Skopje (1963), Alaska (1964), and Turkey (1966). Among recent major earthquakes, it is only for Niigata (1964) that important ground accelerograph records were obtained. The available strong motion records are thus mainly limited to the several dozen accelerograms collected over the past 30 years by the U. S. Coast and Geodetic Survey network in the Pacific Coast states of the United States.

"It is well to emphasize that typical seismological observatories with their sensitive seismographs are not intended to make measurements in the epicentral regions of strong earthquakes and cannot be adapted to do so effectively. Thus, although there are at present some thousand operating seismological stations distributed throughout the world, they cannot be expected to contribute directly to the special problem of the measurement of destructive ground motion."

3.2 Dr. George Housner stated on page 78 of Reference 1, as follows:

"4.5 EARTHQUAKE GROUND MOTION

" -- -- Most strong-motion recordings in the United States have been made on alluvium, with only a few (Helena, Montana, 1935; Taft, California, 1952; Golden Gate Park, San Francisco, 1957) recorded on sedimentary rock. -- --"

A review of the "Recommended Earthquake Design Criteria for the Nuclear Power Plant Unit II Diablo Canyon Site", dated June 1968, establishes that earthquakes B and D are used for design purposes. In order to establish the shape of the expected response spectra for these earthquakes, strong motion accelerograph recordings from two previous earthquakes were used. The record from Golden Gate Park, San Francisco, 1957, was used for earthquake D and the

record for 1952 Taft earthquake was used for earthquake B. These particular past earthquakes were used to assist in determination of response spectra, since the accelerographs in each case were located on sedimentary rock, which is somewhat similar to the Diablo Canyon Site. My concern is not in the choice of strong-motion accelerograph records, but the fact that the choice involved 2/3rds of the total number of strong-motion accelerograph records (on rock) available in the United States, namely 2 out of 3.

There is now one other strong-motion record available, namely from Pacoima Dam, February 9, 1971, San Fernando, California earthquake. An "Analysis of the Pacoima Dam Accelerogram" has been reported by M. D. Trifunac and D. E. Hudson. On page 136 of Reference 2, the final paragraphs read as follows:

"The Engineering Significance of the Pacoima Results. One of the important facts about strong earthquake ground motion is that large ground acceleration amplitudes in themselves do not necessarily indicate severe damage to structures. It is also clear that high spectral accelerations do not always tell the whole story. The response spectrum curves alone cannot give a complete picture of the effects of the time duration of the

acceleration history. These facts have been clearly demonstrated by the spectra calculated for the Parkfield earthquake (Housner and Trifunac, 1967) and the El Centro earthquake (Alford, et al., 1951). Thus the high spectral amplitudes in Figures 2.19 and 2.20 do not necessarily mean that this motion was very destructive for structures of all types. Pacoima Dam, for example, apparently suffered no significant damage.

"The San Fernando earthquake with strong motion lasting about 7 seconds now becomes an excellent example of a strong ground acceleration of short to moderately long duration. <u>If the shaking had continued for another few seconds much greater damage would have resulted, and many buildings and bridges so far only partially damaged would have collapsed. It is mainly this effect of the duration of shaking on structural damage, that calls for detailed investigations of the pattern of earthquake energy release in time.</u>" (emphasis added)

It would seem appropriate that the design of the Diablo Canyon facilities should consider, <u>in intimate detail</u>, the accelerograph record of Pacoima Dam and the resultant response spectra. It is obvious, from the foregoing quotations, that there is still much to be learned about earthquakes and their effects on structures.

I doubt that, at this time and at this place, the State of the Art is sufficiently advanced to permit the risk free construction and operation of the Diablo Canyon nuclear power facility.

3.3 Page 3 of Reference 3 states as follows:

"Earthquake D: An aftershock of Gutenberg-Richter magnitude 6-3/4 centered anywhere at the site and at a depth of 6 miles. The 6-mile focus depth of the earthquake is the vertical distance to the point of initial rupture. Since the possibility of surface faulting due to this shock is considered extremely remote, the focus must be assumed to occur at the uppermost extent of the subsurface fault plane. (It is assumed that the "tearing" of the fault plane extends downward.) The estimated depth to the center of the fault plane is 12 miles."

Please note that the first two sentences rather accurately describe the San Fernando earthquake as viewed from the Pacoima Dam site. The final two sentences are entirely assumptions which reflect the judgment of the designer. If the designer had assumed the fault plane extending upward with surface faulting occurring, it is remotely possible that the surface fault could intersect the structure housing the nuclear reactor. Under such assumptions, it would have been practically impossible to design and construct the structure with good assurance

that it would not be materially damaged or collapse.

The foregoing discussion is to demonstrate that with different assumptions a nuclear incident very likely could occur.

3.4 Page 3 of Reference 3 states as follows:

"The maximum rock accelerations at the site are estimated to be:

"Earthquake A . . .	0.10g	Earthquake C . . .	0.05g
"Earthquake B . . .	0.12g	Earthquake D . . .	0.20g"

(emphasis added)

Again, an extremely important element related to design involves a matter of assumption and judgment and does not reflect the accelerograph record of Pacoima Dam. That accelerograph record shows numerous peaks between 0.50g and 0.70g. This record indicates considerably higher accelerations and for a much longer period of time than the above estimates. These higher accelerations occurred over a period of time of 3 to 4 times longer than the Golden Gate Park, San Francisco, 1957 record which was utilized to design for Earthquake D.

3.5 Please refer to pages 115 through 123 of Reference 4 entitled, "Response Spectrum Analysis of the San Francisco Earthquake of March 22, 1957" by D. E. Hudson and G. W. Housner, which contains acceleration and velocity response spectrum for the 1957 Golden Gate Park, San Francisco earthquake.

Page 5 of Reference 3 states, "The Design Earthquake D was derived by modifying the S 80° E component of the 1957 Golden Gate Park, San Francisco earthquake and then normalizing to a maximum ground acceleration of 0.20g."

Comparison of the above noted material with the Pacoima Dam accelerograph record (pages 110 through 137 of Reference 2) should be made by the designers of the Diablo Canyon facilities. If such a comparison is made, I doubt that the original design for the Diablo Canyon facilities will still be acceptable.

Is the Pacoima Dam information so totally unreliable and inapplicable to the Diablo Canyon design that it should be completely ignored? I believe not. Remember, the Pacoima Dam record now represents 25% of the well-studied strong-motion records (on rock) available in the United States.

3.6 Refer to Reference 5, Seismic Evaluation of the Diablo Canyon Site. This is the work product of well-known, competent, and experienced seismologists. Their work product is an honest expression of the State of the Art at this time. Their various recommendations represent their best judgment and opinion based upon past history and presently available information.

On pages 7 and 8 of Reference 5, the authors set forth their Summary and Conclusion regarding "The maximum size earthquakes that can be expected to occur during the life of the reactor.

"1) A great earthquake may occur on the San Andreas fault -- --"

Comment: The last great earthquake on this portion of the San Andreas fault occurred in 1857. At that time, it was observed and studied by very few geologists or seismologists and little useful scientific information was obtained regarding surface breaks, aftershocks and secondary faulting.

"2) A large earthquake on the Nacimiento fault -- --"

Comment: Authors investigation revealed that "the activity of the Nacimiento fault system has thus been very low during the past century and a half, we have no

means as yet of determining the character of its behavior pattern, --"

"3) Possible large earthquakes occurring on offshore fault systems that may need to be considered for the generation of seismic sea waves are listed below:"

Comment: -I doubt that sufficiently detailed physical explorations of the offshore fault systems have been made.

"4) Should a great earthquake occur on the San Andreas fault as described in paragraph 1) above, large aftershocks may occur out to distances of about fifty miles from the San Andreas fault, but those aftershocks which are not located on existing faults would not be expected to produce new surface faulting, and would be restricted to depths of about 6 miles or more and magnitudes of about 6-3/4 or less. The distance from the site to such aftershocks would thus be more than 6 miles." (emphasis added)

Comment: At some time or another, secondary faults related to the San Andreas fault were produced; why not now? Answer-- It would make the Diablo Canyon site unacceptable.

There is substantial evidence that earthquake activity has occurred over a period of more than 200 million years. Historical observations of earthquake activity have only been made during the past 150 years. Significant instrumental records have been made only during the past 50 years. It wasn't until 1935 that Dr. Charles Richter defined the magnitude of an earthquake in such a manner that earthquakes could be classified according to size. It has only been during the past several decades that significant strong-motion accelerograph records (near epicenters) have been made.

Any prediction of future earthquakes based upon location of present faults and frequency of seismic events during the past 150 years represents an extremely small observation time compared to the over 200 million years during which there have been similar events. Put another way, if the 200 million years is represented by a 24 hour day, then our observations during the past 150 years would be represented by 1/15th of 1 second. Let me repeat, 1/15th of 1 second. Even with all of the scientific advancements now taking place, it will still be a matter of many years before we have more reliable information. Certainly the people of California should not be put in jeopardy simply because the best presently available means to <u>estimate</u> the size of future earthquakes is primarily professional opinion and judgment.

3.7 I have been informed by reliable sources that the Southern California Edison Company has delayed development of two additional units to the San Onofre nuclear generating plant because of new design criteria being established by AEC. Certain of this criteria is a direct result of observations and study of the San Fernando, California, 1971 earthquake. My information indicates there is considerable thought being given to using 0.7g ground motion acceleration for the design of the additional units.

Assuming my information to be correct, what will be done to strengthen the presently operating unit? Is similar consideration being given to reviewing the Diablo Canyon design? It is very obvious to me that the AEC would be very reluctant to have public discussion of this situation.

3.8 On page 7 of Reference 3 are the "Recommended Damping Values". These are also reflected in Plates 1, 2, 3, and 4 which set forth smoothed response spectra for design Earthquakes B and D. A brief review of these plates will establish that the damping ratio substantially changes the response accelerations in g's.

Refer to Chapter 5, Design Spectrum, pages 95-96 of Reference 1 wherein G. W. Housner states:

"In order to specify the actual strengths of structures it is necessary to prescribe the damping and the allowable design stresses. The actual earthquake forces used in the design of a structure will depend strongly on the damping that the structure is assumed to have. Using a large design spectrum with a large value of damping may give a smaller design force than using a small spectrum with a small value of damping. The actual damping that structures may have when vibrating strongly is not well known, so this must be estimated. Furthermore, a decision must be made as to the allowable design stresses to be used: Should ordinary code values be used, or ordinary code values plus one-third increase for transient loading, or yieldpoint stresses, etc.? It would not be proper to specify a design spectrum without also taking into account the damping values and the allowable stresses that will be used. Similarly, when specifying the damping and the allowable stresses, consideration should be given as to how the design spectrum was established: on the basis of average values, on the basis of an envelope of response spectrum values, on the basis of theoretical considerations, etc. A further consideration is the amount of overstress and damage that would be tolerated in the event of very strong ground shaking for which the probability of occurrence is very small. In all of these considerations, a fixed reference point is the

observed performance of buildings during earthquakes, and this should guide the formulation of the design criteria.

"The effect of the vertical ground motion is usually represented by a design spectrum approximately one-half to two-thirds as large as the horizontal design spectrum. - The vertical and horizontal motions, of course, act simultaneously."

To the best of my knowledge, nuclear power facilities are very unique structures and thus the Diablo Canyon Units have been designed and are being constructed primarily based upon theory, professional opinion and judgment. I believe the people of California are entitled to more than the best that the State of the Art can produce at this time.

None of the foregoing critical comments are intended to detract in any way whatsoever from the capabilities or competence of Hugo Benioff and Stewart Smith or John Blume & Associates, Engineers. They are well recognized as competent, outstanding members of the professions of seismology and engineering. My critical comments are to bring into clear focus what I consider significant gaps in available knowledge and to set forth some of the limitations of the State of the Art.

3.9 Pages 2343 to 2370 of Reference No. 6 are a published manuscript by John A. Blume & Associates Research Division, under the date of July 22, 1969, entitled "Response of High Rise Buildings to Ground Motion from Underground Nuclear Detonations". Briefly stated, the Atomic Energy Commission, through its Nevada Operations Office, conducted tests in which nuclear devices were exploded underground in desolate areas of Nevada. In the Introduction on page 2343, Mr. Blume states as follows:

"For all tests except those in desolate areas, the safety program--under the Effects Evaluation Division--includes a structural response effort concerned not only with specific test safety but with obtaining data and increasing the knowledge of response to nuclear-induced ground motion and improving the ability to predict structural response including any damage. John A. Blume & Associates Research Division (JAB) is the structural response contractor.

"A considerable portion of the data being obtained and the work being done will be of value in the problem of response to natural earthquakes even though this result is a by-product of the nuclear effort. Although there are similarities in studies of natural earthquakes and man-made ground motions there are also differences, including

including advanced knowledge of the specific time of nuclear events and a need for much greater care and accuracy in dealing with them because of the direct responsibilities for safety and for property."

Various instrumental data was gathered from the detonations which had "yields up to 1.2 megatons and estimated equivalent Gutenberg-Richter magnitudes up to 6.4 -- --". Page 2344 states the following:

"The area of responsibility includes all surface structures and features (with their foundations and contiguous soils), whether man-made or natural, that may possibly be affected by proposed ground motion. Ground motion predictions and studies are provided by Environmental Research Corporation (ERC), another safety contractor. Instrumentation for both the ground motion and the structural response efforts is provided and operated by the U. S. Coast and Geodetic Survey, Special Projects Party, Las Vegas, as planned by ERC and JAB for their respective operations, and as approved by Atomic Energy Commission, Nevada Operations Office (NVO). The records obtained are processed and analyzed by ERC and JAB for ground motion and response, respectively. JAB suggested early in the program that response spectra be predicted by ERC prior

to major events in addition to peak particle motion. Structural interpretation of the response spectra will be included in another paper (Blume, in publication)."

The author, Mr. Blume, further states as an introduction to his conclusions:

"Measurements, analyses, and studies thus far in the Las Vegas highrise phase of the structural response program indicate the following for the conditions at Las Vegas, and for ground motion induced by underground nuclear detonations of yields up to 1200 KT at the Nevada Test Site."

Selected portions of the conclusions are reproduced as follows:

"• There is considerable variation of spectral response over the area of the city for a specific event."

"• There are variations in spectral response between events, with reference to period bands at the same station, that are significant and are not solely a function of nuclear yield."

The particular point I wish to make is related to the above-quoted conclusions. In the body of the manuscript, on page 2350, it is stated:

"It is to be noticed in Figures 2 and 3 that there are significant variations in spectral response in different period bands. These variations are inconsistent with yield. For example, in Figure 2 the BENHAM (December 19, 1968) spectrum has a pronounced peak at about 0.44-second period whereas the BOXCAR (April 26, 1968) spectrum has no peak there and has much less spectral response in spite of its yield being essentially the same as that of BENHAM. The GREELEY spectrum showed a slight peak at this period and has a greater response than BOXCAR even though of less yield. In Figure 3 at 2-seconds period, the GREELEY spectrum shows greater velocity amplitude than BENHAM or BOXCAR. Thus at the same station, same component, and with range and azimuth very nearly the same, <u>there are significant variations in response from period band to period band that are not a function of yield</u>." (Emphasis added)

"Obviously, in comparison to the great distance to the source, these small changes in distance are not significant in attempting to explain the great response variations for the same event in the same city. This fact plus the

variations in Figures 2 and 3 for the same station with much different relative response in various period bands from event to event suggest strongly that single records, or even a few records of earthquake motion in a locality, should not be used deterministically. Different earthquakes or even different recordings of the same earthquake at different locations (even though epicentrally and geologically similar) may vary considerably." (Emphasis added)

By his own words, the author has questioned very strongly one of the fundamental assumptions in the recommended earthquake design criteria for the Diablo Canyon facilities made in June 1968 (Reference No. 3). At a later date, July 22, 1969, as a result of test programs authorized and conducted by the Atomic Energy Commission, Mr. Blume has raised serious doubts as to the validity of the original design criteria.

3.10 In conclusion, my position has been well stated by Mr. Karl V. Steinbrugge in Chapter 9 "Earthquake Damage and Structural Performance in the United States", pages 167-8 of Reference 1 as follows:

"The rapid developments being made in the mathematical theory of structural dynamics as they apply to earthquake engineering make it very important to critically evaluate the validity of these theories by actual experience in large earthquakes. Furthermore, earthquake records from strong-motion seismic instruments must be reconcilable with observed earthquake damage.

"Strong earthquakes provide an excellent test of the state of the art of earthquake resistive construction. Building codes' earthquake provisions, which reflect consensus judgment in some design areas having inadequately developed theory or theory that is unconfirmed by records from seismic instruments, must be updated on the basis of new experience. No present building code can cover all of the possible problems and difficulties that arise in earthquake resistive design, and experience is particularly vital for new material assemblies and techniques previously untested by a major earthquake. As in any profession, relevant experience is a vital component in making judgment decisions." (emphasis added)

3.11 At the annual convention of the Structural Engineers Association of California in October, 1970, Henry J. Degenkolb, Chairman of the Ad Hoc Committee on Direction Study rendered a report on the SEAOC Seismic Code which is utilized by the Uniform Building Code for seismic design requirements. The Ad Hoc Committee had the task "to study in depth the basic design criteria" of the Code and Commentary.

The introduction to the report states my position quite clearly with respect to the Seismic Code and the State of the Art as follows:

"INTRODUCTION

"The SEAOC Seismic Code, formally known as the 'Recommended Lateral Force Requirements and Commentary' is a relatively simple statement (of 100 pages) intended to codify an extremely complex problem in engineering. As a simplified document, it has many limitations in that not all of the parameters can be covered and many parameters that are covered are so simplified that they barely cover an 'average' building, if there is such a thing. Notwithstanding these severe limitations, <u>the technical provisions are often treated as absolute fact by many engineers and laymen alike and are often regarded as the complete answer to eliminate all hazard and damage that results from</u>

earthquakes. The whole area of practice of earthquake engineering is one that has had relatively little research until recently and is changing rapidly. New developments in materials have changed construction methods and types and have changed design stresses and even analytical methods. The types of buildings have changed.

"In an attempt to keep the Code up-to-date and current, revisions have been made periodically to the Code and Commentary. At the time it was written and adopted ten years ago, the statement was made in the preface that 'Like any progressive building code, this is an interim code.' The time has come to stand back and take a long hard look at the document in the light of ten years of experience to see if, in general, it is meeting the needs of the public in furnishing the basis for the construction of safe, economical structures."

What follows in the report is an honest down-to-earth discussion which tells much about the State of the Art. Following are selected portions of the report which should give proper perspective to anyone who really seeks the truth.

"Question No. 1. Are the present criteria adequate for the purpose intended?

"On page 33 of the Commentary, we find that it is intended that structures designed in accordance with the Code should be able to:

"1. Resist minor earthquakes without damage.

"2. Resist moderate earthquakes without structural damage, but with some non-structural damage.

"3. Resist major earthquakes, of the intensity of severity of the strongest experienced in California, without collapse, but with some structural as well as non-structural damage.

In most structures, it is expected that structural damage, even in a major earthquake, could be limited to repairable damage.

"Certainly, no engineer can question the desirability of this criteria, nor its basic soundness."

"Question No. 2. Does the present Code and do the practices of structural engineers based on that Code, fulfill that criteria?

"Certainly, any student of the performance of structures during earthquakes will have to admit that the present criteria are not literally being fulfilled. Some of the reasons are either stated or implied in the Commentary. Some were stated or implied in our opening paragraph."

"THE RESULT

"What is the result? Let us go back to the basic criteria: no damage in minor earthquakes; non-structural damage in moderate earthquakes; no collapses in major earthquakes. To refresh your memories, the magnitude of earthquakes as rated by seismologists is somewhat as follows: Great -- above 7-3/4; Major -- 7 to 7-3/4; and moderate -- 6 to 7.

"In October 1969, Santa Rosa was hit by a 5-1/2 Richter magnitude earthquake -- minor according to the seismologists. The Welfare Building had recently been designed and built. The structure was conservatively designed to more than twice our current code requirements. There was much non-structural damage and 80% of the columns suffered structural damage.

"In 1967, a 6.0 (moderate) earthquake hit Venezuela. The 10 story Palace Corvin was designed to 2-1/2% G which is 75% of our present Zone 3 requirements. Half of it collapsed.

"The 11 story Mansion Charaima, designed for 5% G -- in excess of our code requirements -- lost the top four stories.

"The Macuto Sheraton Hotel, designed greatly in excess of SEAOC requirements had severe column failure.

"In 1964 an 8.4 earthquake hit Alaska. The 6 story Four Seasons Apartment House designed to our code requirements collapsed.

"In 1968 about ten 3 and 4-story concrete schools collapsed in the Tokachioki, Japan earthquake having a Richter magnitude of 7.8. The small amount of design checking that the State of California OAC was able to do indicated that the design of these schools would meet the requirements of Title 21 of our Code."

"The final question relates to revisions of the Commentary to suit changed conditions and knowledge.

"1. First, the goals and criteria must be corrected to something that can be delivered by both the Code, the engineer and the building official. Let us not mislead the public and incidentally acquire more professional liability than we now have.

"2. The Commentary must explain the purpose and limitations of a code so as to correct the misconceptions that the public and many engineers have.

"3. The Comentary must furnish background information to the engineer -- not only the California engineer but to those in other areas. There should be more references.

"4. Note areas of weakness -- State of the Art -- and needed research and, possible direction for future code revisions. It is important that the public know the limitations of our knowledge and ability to design within the economic limitations that affect us. (emphasis added)

"5. Certain fundamental items not suited for codification must be explained and discussed, such as tying together, stability, complete stress path, etc. Many structural engineers do not consider these items because they are not specifically in the Code."

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Respectfully submitted,

Stanley H. Mendes S.E. #709

Stanley H. Mendes

STATE OF CALIFORNIA)
) ss
COUNTY OF SANTA BARBARA)

On January 23, 1973, before me, the undersigned, a Notary Public in and for said State, personally appeared STANLEY H. MENDES, known to me to be the person whose name is subscribed to the within instrument, and acknowledged to me that he executed the same.

WITNESS my hand and official seal:

OFFICIAL SEAL
STANLEY W. ABBOTT
NOTARY PUBLIC-CALIFORNIA
SANTA BARBARA COUNTY
My Commission Expires Sept. 30, 1973

226 East Canon Perdido St., Santa Barbara, Calif. 93101

STANLEY W. ABBOTT