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U.S. NUCLEAR REGULATORY COMMISSION

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TO:	FROM:	DATE OF DOCUMENT
Mr. John F. Stolz	Pacific Gas & Electric Co. San Francisco, California Philip A. Crane, Jr.	12/20/77
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DESCRIPTION

(1-P)

ENCLOSURE

Response to NRC ltr. of 8/24/77 which contained questions on Amend. No. 50 to operating license application re Seismic Evaluation.....

(9-P)

PLANT NAME: Diablo Canyon Units 1 & 2
RJL 1/3/78

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MALCOLM H. FURBUSH
ASSOCIATE GENERAL COUNSEL

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

December 20, 1977

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ATTORNEYS

Mr. John F. Stolz, Chief
Light Water Reactors Branch No. 1
Division of Project Management
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: Docket No. 50-275-OL
Docket No. 50-323-OL
Diablo Canyon Units 1 and 2

Dear Mr. Stolz:

Your letter of August 24, 1977 contained questions on Amendment No. 50 to our operating license application. Responses to many of these questions were transmitted by our letters dated November 2, 1977 and December 1, 1977.

Enclosed are 40 copies of the responses to the balance of the questions: 3.67(a), 3.67(b), 3.68, 3.84, 3.85 and 3.93.

Kindly acknowledge receipt of the above material on the enclosed copy of this letter and return it to me in the enclosed addressed envelope.

Very truly yours,

Philip A. Crane, Jr.

Enclosures
CC w/enc.: Service List

BALANCE OF RESPONSE TO NRC

LETTER OF AUGUST 24, 1977

3.67 On page 4-9, Section 4.2.1, please clarify the following:

(a) By including the 5% (or 7%) equivalent eccentricity in the mathematical model, the resulting frequencies and mode shapes for a coupled motion will be changed to those which no longer represent the physical characteristic of the containment. The definition of H_{TR} and H_{T05} on Page 4-11 appears to be misleading. H_{TR} is not the horizontal response due to horizontal ground motion. Rather, H_{TR} is a horizontal component and H_{T05} a torsional component of a coupled motion due to a horizontal input. In this method of analysis, H_{TR} and H_{T05} cannot be separated.

Response:

In the evaluation of the Diablo Canyon Power Plant for the postulated Hosgri earthquake and DDE models and procedures were employed as described in Section 4.1. This section contains the Specification for Seismic Review of Major Structures for 7.5M Hosgri Earthquake developed with the NRC in February 1977.

The stiffness of the elements is based on the gross concrete section of the containment shell and a nominal modulus of elasticity $E=3.54 \times 10^6$ PSI.

Consideration of the reinforcing steel would result in increases in bending and shear stiffnesses of the elements and a corresponding increase in the fundamental frequency. Cracking of the concrete, on the other hand, would have the opposite effect, tending to offset the frequency increase due to the reinforcing as well as increasing damping. More importantly, the first mode response represents a major portion of the total response and corresponds to the peaks of the Blume and Newmark spectra. Thus a frequency shift would result in a reduction (Blume spectra) or no change in response (Newmark spectra).

In addition, the interaction of steel reinforcing and concrete and the time dependent stiffness effects, including cracking, of concrete sections under dynamic loads is a problem for which no theoretically rigorous solution is available.

Any analysis of structures requires that a number of judgments, based on engineering experience, be made in order to realistically determine the behavior of the structures. The models as used in the Hosgri evaluation and the assumptions used in their formulation were based on previous experience with earlier analyses and other structures.

Amendment 50 to the FSAR, entitled "Seismic Evaluation for Postulated 7.5M Hosgri Earthquake," submitted June 3, 1977, contains a number of papers describing the conservatisms inherent in the conventional design and analysis of structures. D-LL6, 18A, 18B, 18C, and 21 describe the safety factors resulting from the use of average concrete strengths, two equal horizontal seismic components, period variations, lower bounds of design equations, and seismic stress combinations. The combination of these factors yields a significant margin of safety between calculated and real responses of structures to seismic motions.

3.67 (b) How would the comparison be if the forces and moments were computed by summing up:

(i) responses using uncoupled horizontal mode shapes and frequencies, and

(ii) responses due to torsional moment which is the product of the equivalent eccentricity and the inertia forces from (i) above.

Response:

The bottom 20 feet of the cylinder was treated as a homogeneous section for the purposes of a dynamic analysis. The embedded beams and slip surfaces were considered active in resisting radial shears and moments under internal pressure but ineffective in resisting seismic forces. Consideration of the slip surfaces would result in a slightly lower frequency, additional damping, and as a result, lower seismic forces.

3.68 On page 4-12, par. 4, the statement is made that "vertical acceleration and displacement responses----------of the same axisymmetric model". Provide a comparison of results obtained by the two different techniques, namely, response spectrum analysis and time history model superposition analysis.

Response:

The following table provides a comparison of accelerations and displacements from the vertical excitation of the exterior containment structure. Values obtained by the time history and response spectrum techniques are listed in the left and right hand portions of the table, respectively.

ACCELERATION - VERTICAL ANALYSIS
(G's) (NEWMARK τ = 0 x 2/3)

Nodal Point	By AXIDYN....(t-h Algorithm)		*As Presented May 9, 1977 Report	
	HORIZONTAL	VERTICAL	HORIZONTAL	VERTICAL
2	.023	1.543	.02	1.600
8	.139	1.009	.15	1.020
10	.276	.860	.28	.882
14	.276	.792	.28	.810
17	.110	.745	.11	.759
19	.134	.689	.14	.703
20	.163	.624	.17	.633
22	.171	.571	.18	.575
23	.157	.537	.16	.538

*Computed by MATRAN (from mode shapes & freq. of AXIDYN)

DISPLACEMENTS - VERTICAL ANALYSIS
(INCHES) (NEWMARK τ = 0 x 2/3)

Nodal Point	By AXIDYN (t-h Algorithm)		**As Presented May 9, 1977 Report	
	HORIZONTAL	VERTICAL	HORIZONTAL	VERTICAL
2	.001	.100	.002	.108
8	.007	.069	.009	.076
10	.016	.058	.020	.066
14	.016	.050	.020	.056
17	.006	.044	.008	.049
19	.007	.037	.009	.041
20	.009	.028	.011	.031
22	.010	.018	.012	.020
23	.010	.009	.012	.010

**Computed by ASHSD4 (Response Spectrum Method)

3.84 Fig. 4-108 shows the base of the model at El. 85'-0. Clarify how was the response of the structure below E. 85'0 computed? In addition justify why the input motion was not at the foundation mat elevation.

Response:

The foundation of the Auxiliary Building is generally divided between two elevations, with part of the structure supported at elevation 85'0" (area G) and at elevation 100'-0" (Fuel Handling Area) and part at elevation 60'-0". The structure between elevations 60'-0" and 85'-0" is characterized by a large number of shear walls relative to levels of the structure above 85'-0". Because of this rigid portion of the structure, the rock material at the site, the shape and construction of the super-structure, because of the embedment, and because of professional judgement based upon all these considerations, the base of the model was selected at elevation 85'-0". A rigid foundation structure does not amplify the motion, it tends to transmit energy away from the base. The only exception would be rocking amplification which was not considered as significant in this case because of the rock material, the embedment and the dimensions involved.

In design of the Auxiliary Building, the structure below elevation 85'-0" was assumed to have the same seismic response accelerations as the floor at elevations 85'-0".

3.85 On Page 4-26, Par. 1, the statements are made that "the interaction between the structure and the upward-sloping grade.....on the east side of the building." It is our understanding that the soil springs were used to account for the effect of embedment, since the model shown in Fig. 4-108 was fixed at El. 85'-0. Provide justification for the use of the elastic half-space theory in deriving the spring stiffnesses.

Response:

The elastic half-space theory has been used many times and in many plants for the derivation of soil spring stiffnesses. Sometimes this is supplemented with finite element analysis; sometimes springs are derived entirely from finite element analysis. Depending upon specific conditions and how well the conditions are represented by numerical values and models, any or all of these procedures can be satisfactory in the current state of the art.

The Diablo Canyon site is rocky and it is reasonably uniform to considerable depth without abrupt change in subsurface characteristics and without pronounced layering. Moreover, the site was thoroughly investigated with trenches and by other means. The method used for this structure and site was satisfactory in view of the reasonableness of the assumptions of elastic, homogeneous, isotropic, and semi-infinite conditions inherent in elastic half-space modeling.

For further discussion of this subject reference is made to:

Richart, F. E. Jr.; Hall, J. R. Jr.; Woods, R. D., "Vibrations of Soils and Foundations," Prentice-Hall, New Jersey, 1970.

Whitman, R. V., and Richart, F. E., "Design Procedures for Dynamically Loaded Foundations," Journal ASCE, Soil Mechanics and Foundation Division, SM6, November 1967, pp. 169-193.

Whitman, R. V., "Soil Structure Interaction" in "Seismic Design for Nuclear Power Plants," The M.I.T. Press, Cambridge, 1970.

Section 3.7.2, Standard Review Plan, U.S. Nuclear Regulatory Commission, June 1975.

3.93 On pages 4-48 and 50, referring to the intake structure, what conservatism, if any, is involved in the increase of response in each horizontal earthquake input by a factor of 1.10, rather than using a value of eccentricity of 5% of the width.

Response:

We have made a torsional analysis of the Intake Structure by applying moment equivalent to the structure response multiplied by a value of 5% of the width. This torque was applied to the north-south model (the most critical direction) in order to study the possible conservatism resulting from a 10% increase in responses. The following two structural characteristics were influential in the torsional response of the Intake Structure. First, the structure consists of a rigid box system with a flexible appendage on the west, or seaward face of the structure. The effect of a torsional input applied at the center of rigidity of the structure is resisted within the rigid portion of the structure and not transmitted to the flexible, more critical elements. Secondly, the 5% eccentricity is small in comparison to the natural geometric eccentricity considered in the computer model. Therefore, our study showed that a 5% eccentricity resulted in negligible increases in response and hence the 10% increase in responses used in the report is conservative to the same degree.

50-275

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

December 8, 1977

Docket Numbers 50-275
and 50-323

Mr. A. Arenal, Vice President
Southern California Edison Company
P. O. Box 800
Rosemead, California 91770

Dear Mr. Arenal:

Thank you for your letter to Edson Case dated November 15, 1977, which provides additional information concerning the assessment of California's potential electrical supply situation for 1978, assuming the current drought continues.

This information will be useful in our consideration of the Diablo Canyon matter.

Sincerely,

Harold R. Denton

Harold R. Denton, Director
Division of Site Safety and
Environmental Analysis
Office of Nuclear Reactor Regulation

MA 4

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Southern California Edison Company

P. O. BOX 800

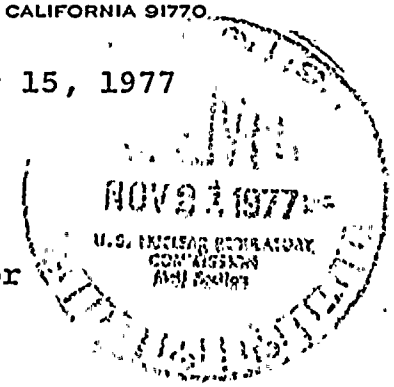
2244 WALNUT GROVE AVENUE

ROSEMEAD, CALIFORNIA 91770

A. ARENAL
VICE PRESIDENT

TELEPHONE
213-572-1476

November 15, 1977



Mr. Edson Case, Acting Director
Office of Nuclear Reactor
Regulation
Nuclear Regulatory Commission
1717 H Street, N.W.
Washington, DC 20555

Dear Mr. Case:

In a letter to you dated October 27, 1977, Richard L. Maullin, Chairman of the California Energy Resources Conservation and Development Commission (CERCDC), provided a summary assessment of California's potential electrical supply situation for 1978, assuming the current drought continues. Although the data upon which Mr. Maullin and the CERCDC staff base their analysis are essentially valid at this time, I do not agree with their conclusion that a reserve margin of 9.6% is adequate for the state. This represents an extremely low reserve level, and it is unrealistic to assume that the combined efforts of the California utilities will result in the maintenance of uninterrupted supply to all customers with the low-risk probability cited by the CERCDC staff.

The CERCDC staff study noted alternatives to operation of Diablo Canyon, with reference to certain Southern California Edison resources which should be clarified as follows:

SCE Ormond Beach Units 1 And 2

The CERCDC staff study assumed a capacity restriction of 80 MW for Ormond Beach Units 1 and 2. The Ventura County Air Pollution Control District variance governing operation of these units provides for their operation up to maximum capacity under emergency system conditions, and the 80 MW involved represents only about 0.2% of the projected statewide reserve margin.

SCE Long Beach Units 8 And 9

The California Coastal Commission permit for this facility limits the normal operation of the plant to a monthly capacity factor of 34 percent. However, the permit does provide for operation at higher capacity factors under emergency situations. The Energy Commission staff study assumed the full-rated capacity of the units during the summer months of 1978; therefore, no additional capacity can be made available from this source other than that which was included in the estimate yielding the 9.6% reserve margin.

San Onofre Unit 1

The study prepared by the CERCDC staff assumed that San Onofre Unit 1 would be out of service for refueling and inspection for about seven weeks starting July 1, 1978. This forecast date is regularly reviewed based on current conditions and projections and accordingly modified. As an example, the start of this outage is not presently expected to occur earlier than September 15, 1978. Assuming this revised schedule, the statewide resource reserve margin would increase only slightly from 9.6% to 10.9% in August 1978.

However, it should be recognized that, based on current information, this increase in statewide reserve margin, resulting from a change in the refueling schedule of San Onofre Unit 1, would be at least partially offset by other changes in data, such as maintenance schedules, unit in-service dates, and outages. Furthermore, generating capacity typically not available for service, due to forced outages, is not reflected in the statewide reserve margins and is several times the increase resulting from the change in refueling schedule of San Onofre Unit 1.

Energy Banking

The CERCDC staff study mentions taking advantage of banking energy with the Northwest. This approach is fraught with risk. If the California utilities were to bank energy in the Northwest, this energy would be the first to be spilled and lost in the event of high run-off. This spill risk would extend through the full run-off period until summer when the California utilities desire the energy returned. Timely return of banked energy by the Northwest is predicated on having adequate availability of both Northwest generating capacity and transmission capacity.

It should be noted that banking energy in the Northwest will not change the statewide reserve margin.

Examination of the supply alternatives offered by the CERCDC staff study indicates that the magnitude of potential contribution from these sources is insufficient to bring the projected reserves to a realistically adequate level in 1978. The contribution of other alternatives, such as delamping to reducing the expected 1978 peak, is highly speculative and likely to be minimal. The combined electrical systems in California were pressed near the limit in 1977; therefore, the utilities and the agencies involved must thoroughly consider means of meeting California's critical supply needs, and the serious liabilities associated with a shortfall.

Sincerely,

A. Arenal

A. ARENAL

cc: Richard L. Maullin, Chairman
Energy Resources Conservation
and Development Commission

Robert Batinovich, President
California Public Utilities Commission

Charles Curtis, Chairman
Federal Energy Regulatory Commission

Eugene Neblett
Acting Regulatory Engineer
Federal Energy Regulatory Commission

R. E. Morris, President
San Diego Gas and Electric Company

B. W. Shackelford, Senior Vice President
Pacific Gas and Electric Company

Lewis H. Winnard
General Manager and Chief Engineer
Los Angeles Department of Water and Power

W. C. Walbridge, General Manager
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Mr. R. E. Morris, President
San Diego Gas & Electric Company
P. O. Box 1831
San Diego, California 92112

Dear Mr. Morris:

Thank you for your letter to Edson Case dated November 28, 1977, which provides additional information concerning the assessment of California's electrical supply situation for 1978 should drought conditions continue for a third year.

This information will be useful in our consideration of the Diablo Canyon matter.

Sincerely,

Harold R. Denton

Harold R. Denton, Director
Division of Site Safety and
Environmental Analysis
Office of Nuclear Reactor Regulation

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SAN DIEGO GAS & ELECTRIC COMPANY
P.O. BOX 1831 SAN DIEGO, CALIFORNIA 92112
(714) 232-4252

R. E. MORRIS
PRESIDENT

FILE NO.

November 28, 1977

Mr. Edson Case, Acting Director
Office of Nuclear Reactor Regulation
Nuclear Regulatory Commission
1717 H Street, N.W.
Washington, D.C. 20555

Dear Mr. Case:

In a letter dated October 27, 1977, Richard L. Maullin, Chairman of the California Energy Resources Conservation and Development Commission, provided you a summary assessment of California's electrical supply situation for 1978 should drought conditions continue for a third year. The data used by the CERCDC Staff is still generally valid, with some changes resulting from revised generating unit maintenance schedules. However, I cannot agree with the conclusion that a statewide reserve margin of 9.6% is adequate, since this thin a margin can be practically eliminated by the outage of only one or two of California's large generating units.

It should be noted that two of the four major California utilities will be faced with reserve margins of less than 10% should the drought continue. Based on data used by the CERCDC Staff, San Diego Gas & Electric Company's reserve margin would be reduced to 189 Mw (9.8%). The loss of only one generating unit could thus result in the implementation of planned service interruptions necessary to insure system integrity.

Forced outages involving 10% or more of installed capability do in fact occur. As an example, On June 28, 1976, SDG&E experienced a forced outage situation totaling 11% of total capability, while at the same time experiencing an all-time system peak demand during a heat wave. Should this occur in 1978 (assuming continuation of the drought), it is quite probable that we would have to shed customer load.

In 1977, the California systems were stretched to near limits. Should the drought continue, the 1978 outlook appears far more serious.

I am familiar with the letter which was sent to you by Pacific Gas & Electric Company on November 2, 1977. I think that the conclusions reached in that letter are valid and I urge you to exert every effort to reach an early decision on the licensing of Diablo Canyon.

Sincerely,

R. E. Morris
President

REM/cy

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R. E. Morris
President

REM/cy

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