ENCLOSURE NO. 1

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

MAY 8 1978

MEMORANDUM FOR: John Stolz, Chief, Light Water Reactors Branch No. 1, DPM

FROM: J. Carl Stepp, Chief, Geosciences Branch, DSE

SUBJECT: DIABLO CANYON NUCLEAR POWER PLANT PROBABILISTIC EARTHQUAKE HAZARD STUDY

The Pacific Gas and Electric Company (PG&E) has performed a probabilistic evaluation of the earthquake hazard at the Diablo Canyon Nuclear Power Plant (DCNPP) site (Blume, 1977a, 1977b, 1977c Blume and Kiremidjian, 1978). This memorandum addresses the study contained in these reports. It does not however address that portion of Blume, 1977a which discusses spectral response accelerations.

Several models are available for the calculation of earthquake recurrence probabilities (Cornell, 1968; Der-Kiureghian and Ang, 1977). In their basic elements these models are equivalent, i.e. they are based on the assumptions that the occurrence of earthquakes constitutes a Poisson process and that the distribution of earthquake in size is exponential or bounded exponential. All require definition of source regions based on an interpretation of tectonic elements and seismicity in order to determine the distribution parameters of the model. In addition they require the specification of attenuation relationships and functions relating source dimension to earthquake strength. The model used by Blume (1977a) for the DCNPP study is a refinement of the models in the published literature which have become widely accepted.

In addition to the PG&E study, the probabilistic earthquake hazard for the DCNPP has been evaluated by Anderson and Trifunac (1976) and Ang and Newmark (1977). Each of these investigations derives the distribution parameters based on different tectonic assumptions and data samples and uses a different attenuation relationship. I have not made a comparison of the impact of these different data assumptions and physical relationships on the results obtained in the three studies. I have instead attempted to evaluate the reasonableness of the assumptions and physical parameters used in the PG&E study to represent the region of the DCNPP site.

The Blume, 1977a study incorporates a number of assumptions which are stated or implied:

(1) the seismicity of the Coast Ranges southwest of the San Andreas fault zone and the adjoining offshore region between 34.5° and 37° latitude in the time interval of 1930 to 1975 reflects the rate of tectonism in this region,

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(2) the sample drawn from this region is adequate for determinating the distribution parameters of the model,

(3) all the estimated earthquake activity in the sample region will occur on four faults (Santa Lucia Bank, Hosgri Nacimiento and Rinconada-Ozena) and none elsewhere,

(4) the four faults all have the same activity rate,

(5) earthquakes occur randomly in each source,

(6) the length of rupture is described by the relationship of Patwardhan et. al. (1975).

(7) attenuation of motion is described by the relationship given in Blume (1977d).

The first four of these assumptions impact the degree to which the activity rates determined for the various contributing faults actually reflect current tectonic rates. Assumptions 5 and 6 govern the spatial distribution of earthquakes. The assumption that the historic seismicity record (1930 to 1975) of the Coast Ranges and adjacent offshore area between Point Argeullo and Santa Cruz represents the ongoing rate of tectonic activity in the region cannot be directly tested. Different sectors of the San Andreas fault zone exhibit different rates of ongoing seismicity and it is not known how the seismicity may shift spatially with time (Allen, 1968). Thus a short seismicity sample drawn from a limited part of the San Andreas fault system may not reflect the true rate of tectonism. The applicant has addresses this in Blume (1977b), in which the distribution parameters (activity rates for faults) were determined from their estimated total slip during the past 10,000 years and 20 x 10^6 years. The applicant considers the 10,000 year interval to be the more appropriate internal for determining the rates of activity on faults in the site area. We consider this reasonable, since the current tectonic pattern has likely not been active during the entire past 20 x 10^6 years. The probabilities of exceedance of ground motions near those used for the reevaluation of the DCNPP units obtained by this independent method are lower than those obtained by Blume (1977a) by nearly a factor of two. This provides independent support of the adequacy of the seismicity sample used by Blume (1977a).

The assumption that the estimated earthquake activity will occur on only four through-going faults in the site vicinity may be conservative because it tends to result in a higher activity rate for the Hosgri fault. All of the studies show that the probabilistic earthquake hazard at the DCNPP site is controlled at higher levels of acceleration by activity on the Hosgri fault.

Different attenuation relationships and fault slip-earthquake magnitude relationships have been shown to have a significant impact on probabilistic earthquake hazard evaluations (Der Kiureghian and Ang, 1977). Uncertainty in the fault rupture length earthquake magnitude relationship has apparently not been accounted for in the PG&E studies. Although uncertainty in the attenuation relationship has been accounted for, the Blume (1977a) attenuation relationships appear to produce values near the source that are low at all magnitudes when compared with the available data by possibly a factor of two. The impact of this on the probabilistic earthquake hazard values obtained in Blume (1977a and 1977b) has not been evaluated. References are attached.

J. Carl Stepp, Chief
Geosciences Branch
Division of Site Safety and
Environmental Analysis

Attachment:
As stated

cc: w/attachment
H. Denton
R. Boyd
W. Gammill
D. Davis
D. Goddard
D. Allison
R. Hofmann
D. McMullen

References

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