ENCLOSURE 12

United States Department of the Interior

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IN REPLY REFER TO:

Branch of Engineering Geology and Tectonics

March 19, 1986

Dr. Leon Reiter
Reliability & Risk Assessment Branch
U.S. Nuclear Regulatory Commission
MS 244
7920 Norfolk Avenue
Bethesda, Maryland 20014

Dear Leon:

Enclosed are my comments regarding ground motion issues raised at the March 11 and 12 meeting on PG&E's Long Term Seismic Program. Some of these issues are being addressed by PG&E, but it was not clear from their presentation with what detail they are addressing them. This comes from their current lack of written documentation. If you have any further questions please call at (FTS) 776-1613.

Sincerely,

Ken

Kenneth W. Campbell

Enclosure

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GROUND-MOTION ISSUES

PG&E LONG TERM SEISMIC PROGRAM

Meeting of March 11-12, 1986, Bethesda, Maryland

1. Topography: The proximity of a bluff to the DCNPP facilities raises the possibility that ground motion could be enhanced by topographic effects. the significance of these effects could be assessed analytically with theoretical modeling and experimentally with an appropriate array of recordings at the site.

2. Site Response: Existing and future recordings of strong ground motion at the site should be used to study site response at DCNPP. By comparing the recordings with others obtained in California at similar distances and magnitudes and with estimates based on attenuation relationships, one can assess whether the site has systematically higher or lower ground motion as compared to the "average" California site.

3. Sense of Slip/Fault Dip: Amplification factors have been used to adjust ground-motion estimates for the sense of slip and fault dip geometry. These factors should have a sound theoretical or empirical basis. Numerical modeling of ground motion could help define these factors if appropriate radiation patterns and fault geometry are included in the model.

4. Directivity/Passage of Rupture Front: The proximity of the Hosgri fault to the DCNPP facilities raises the possibility that ground motions could be enhanced by directivity effects and passage of the rupture front. The latter includes the potential effects of starting and stopping phases. These issues are best assessed by numerical or theoretical modeling of ground motion.

5. Vertical Ground Motion: There are many factors that affect the ratio of vertical to horizontal ground motion. This is especially true in the near-field where the maximum ground motions may come from different phases. A constant factor should not be used. It should depend on the sense of slip, the fault geometry, phase conversions, etc. This issue could be addressed with both theoretical and empirical studies.

6. Horizontal Components: Treatment of horizontal components should be consistent with the engineering use of stresses computed from these ground motions. Predictions from attenuation relationships can represent the largest horizontal component, the mean of the two horizontal components, both horizontal components, or the random selection of horizontal components.

7. Tabas and Gazli Strong-Motion Records: These recordings are the only strong-motion records obtained at near-source distances (R≤10 km) from earthquakes of $M_s \geq 7$. Thus, they should be carefully considered when estimating ground motions from a large Hosgri event. They could also be used to calibrate the numerical ground motion model for large nearby earthquakes.

8. Standard Deviation of Ground Motion Estimates: Probabilistic estimates and upper-fractile deterministic estimates of ground motion are extremely sensitive to the standard deviation associated with these estimates. Therefore, both the value of this standard deviation and the type of probability distribution should be carefully chosen. The standard deviation should reflect the uncertainty associated with model parameter variability (associated with the regression coefficients) as well as data dispersion.

9. Seismic Hazard Analysis: Since the seismic hazard is controlled by the nearby Hosgri fault, several parameters associated with this fault are extremely critical to the hazard results. Careful consideration should be given to (1) the attenuation relationship, (2) the standard deviation of the ground motion estimates, (3) the slip rate, (4) the geometry (especially the down-dip geometry) of the fault, (5) the rupture dimensions of hypothesized earthquakes, (6) the use of a Gutenberg-Richter vs. characteristic earthquake occurrence models, and (7) the minimum and maximum magnitudes.