THE GILINSKY/BRADFORD DISSENTING OPINION ON NRC'S FAILURE TO REVIEW THE APPEAL BOARD'S APPROVAL OF DIABLO CANYON'S SEISMIC DESIGN

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

COMMISSIONERS:

Nunzio J. Palladino, Chairman
Victor Gilinsky
Peter A. Bradford
John F. Ahearne
Thomas M. Roberts

In the Matter of	
PACIFIC GAS & ELECTRIC COMPANY	Docket Nos. 50-275 OL 50-323 OL
(Diablo Canyon Nuclear Power Plant, Units 1 and 2)	

OPINION OF COMMISSIONERS GILINSKY AND BRADFORD ON COMMISSION REVIEW OF ALAB-644 (DIABLO CANYON SEISMIC PROCEEDING)

The Commission has had in hand since June 16, 1981, the Appeal Board's decision approving the seismic design of the Diablo Canyon nuclear power plant. The Board's decision deals with the most important issue in this Operating License proceeding in view of the discovery of a nearby earthquake fault after plant construction was well underway, and the subsequent need to redo the seismic design.

Normally, the Commission allows itself 30 days to decide whether to review an Appeal Board decision. If the Commission does not act in that time the decision is not taken up for review. In this case, the General Counsel provided the Commission with a twenty-two page memorandum on the legal merits of the Board's

decision and, at the Commission's request, the Office of Policy Evaluation, after a six-week study involving four consultants,[1] produced an 89-page analysis of the technical aspects of the decision. After receiving these memoranda, the Commission found itself unable to decide whether to take review. Altogether over a period of nine months, the Commission extended the time for deciding whether to take review thirteen times. This week the last extension was allowed to lapse.

The issues in the Appeal Board decision need to be distinguished from those of the ongoing reverification of the Diablo Canyon seismic design which has received so much attention recently. The Appeal Board decision deals with whether the bases of the seismic design, as formulated by the applicant and approved by the NRC staff and Licensing Board, are adequate. The reverification program assumes the correctness of those bases and looks into whether they were properly applied in the detailed design of the plant structures and equipment.

The Appeal Board decision deals with the fundamental "response spectrum" at the site--in effect, the frequency and maximum amplitude of the various oscillations of structures attached to the plant's foundation. These maximum oscillations are calculated on the basis of the agreed-upon maximum earthquake, and all safety-related structures and equipment must be designed to withstand them. The Appeal Board deals, in particular, with the adequacy of the new seismic design standard chosen after the

discovery of the nearby Hosgri fault, which had not been taken into account in the original design of the plant. The case presents a number of novel problems, particularly as the assumed earthquake location is very near the plant, and the choices inescapably involve a good deal of judgment.

The difficulty the Commission found itself in, as the nine months of indecision betrays, is that the Appeal Board's decision is not a satisfactory one. On some points it can probably be rescued by different reasoning, though even that would not eliminate the need for review because of the decision's precedential significance. On at least one point, however, the use of the so-called "tau effect" to permit a substantial across-the-board relaxation of the seismic standard applied to the plant, the Board's reasoning is utterly inadequate and is very likely wrong.

Without Commission review, not only will questions remain about the correctness of the Diablo Canyon seismic design, but the Board's decision will stand as an unfortunate precedent which will undermine application of the Commission's regulations on seismic design.

Procedural Background

The NRC issued the Construction Permits for Diablo Canyon Units 1 and 2 in 1968 and 1970, respectively. These permits were issued on the assumption that the plants could be expected to face, at most, a 6.75 magnitude earthquake at a distance of about 20

miles. In 1971, Hoskins and Griffiths published a paper which established the existence of a fault approximately 3 miles off-shore of the Diablo Canyon site. The existence of the fault--called the Hosgri fault--was confirmed in a 1974 study. As the plant was largely constructed, this forced a reevaluation of the seismic design at an awkward time.

After reanalysis, the applicant, the NRC staff and the ACRS concluded that, with certain specified modifications, the plants could withstand the more severe earth movements which must be assumed as a result of the Hosgri fault discovery. This followed a determination by the U.S. Geological Survey that the maximum Hosgri fault earthquake against which the plant had to be designed was one of magnitude 7.5. The applicant and NRC staff did not believe this was the right choice, but apparently convenience dictated its acceptance for the purposes of the proceeding. Much of the difficulty in this case stems, in our view, from the formal acceptance of this standard, but the less-than-wholehearted application of it.[2]

In the course of the Diablo Canyon Operating License proceeding, the Licensing Board conducted evidentiary hearings on the seismic issues between December 1978 and February 1979. At the close of this part of the proceeding, the parties stipulated, and the Board agreed, that it would be conservative, in view of the existence of the Hosgri fault, to attribute a magnitude of 7.5 to the Safe Shutdown Earthquake ("SSE")[3]. The Licensing Board

also fixed the maximum vibratory ground motion that an SSE might induce at the plant site and concluded that the seismic reanalysis and redesign were adequate to withstand this SSE.[4]

The Joint Intervenors appealed several aspects of this decision to the Atomic Safety and Licensing Appeal Board, and were joined in their appeal by Governor Brown, participating as an amicus curiae. On June 16, 1981, the Appeal Board issued its decision affirming the Licensing Board's finding that the Diablo Canyon plants were adequately designed to withstand a 7.5 magnitude earthquake on the Hosgri fault. Since that date, the case has been before the Commission awaiting its decision on whether or not to take review.

Technical Background

As stated above, after the discovery of the Hosgri fault and the subsequent analysis by the U.S. Geological Survey, the parties to the Diablo Canyon proceeding agreed to an earthquake of magnitude 7.5 on a nearby portion of the fault as the fundamental seismic event against which the plant would be designed. Since the plant was in large part already constructed at this point, the reanalysis and redesign understandably did not proceed as they would have in a plant yet to be built. Every advantage was taken of slack in safety margins left in the pre-Hosgri analysis, both in developing the response spectrum and in its application. To cite a couple of examples: a larger damping value was used in analyzing structures (7 percent instead of the earlier 5

percent), which reduced the effect of ground vibrations on the structures. At the same time, credit was taken for the actual -- "as-built" -- strengths of materials (rather than for the minimum required strengths, as is the usual practice) so that larger vibrations became tolerable. These choices were not improper, but they do add significance to further substantial relaxations in the seismic standards for the plant on the basis of the "tau effect". The point is that these further relaxations come on top of a redesign that has already shaved safety margins to the extent permitted in the regulations.

Probably most important along these lines was the choice of the earthquake record used in developing the response spectrum, and the manner in which that record was used. Because no record was available from a station close to a 7.5 earthquake, the applicant used the seismic record, known as the Pacoima Dam record, from a recording station near the center of a 6.5 earthquake (the 1971 San Fernando Valley earthquake). This record could plausibly be taken to represent a larger magnitude earthquake, in particular because it included the largest horizontal acceleration recorded up to that time, about 1.2 g. Nevertheless, the Board's handling of this issue is unsatisfactory. As the Commission's Office of Policy Evaluation put it:

> "It is not clear, however, from the Boards' records if the Pacoima Dam record in the frequency range of interest (1-10 Hz) represents a deviation from that expected for a 6.5 M

earthquake. Most of the testimony on Pacoima Dam centered on a frequency range of little practical interest (i.e., near 33 Hz) regarding excitation of structures important to safety. We found no supporting statement on the record which indicated that the Pacoima Dam record substantially exceeded that expected for a 6.5 M earthquake in the frequency range of 1-10 Hz. USGS Circular 672 (p.7) indicated that in the frequency range of 1-10 Hz, the Pacoima Dam record closely resembled what one would expect for a 6.5 M earthquake."[5]

Which brings us to the final point, that on top of all this trimming, the Board permitted a further substantial reduction, more-or-less across the board, in the response spectrum.

"Tau Effect"

The "tau effect", defined by Dr. Nathan Newmark, the NRC staff consultant, is used to describe the filtering effect that large rigid foundations have on the motion imparted to the building's structure during an earthquake. Newmark's estimate of the effect was used to justify a reduction in the response spectrum for each of the important structures in the reanalysis of Diablo Canyon. Newmark's analysis for the reactor containment reduced the acceleration response spectrum by about 20 percent over the frequencies of interest.[6]

A reading of both the Appeal and Licensing Boards' decisions shows an almost total reliance on the opinions of Newmark to justify the tau effect. Newmark in turn apparently relied heavily on the work of Yamahara. Yamahara's work dealt largely with an odd-shaped building quite unlike any of the structures at the Diablo Canyon plant and with earthquakes well below the magnitudes considered at the Diablo Canyon site. Neither of these discrepancies are explained in either Board decision. The Licensing Board's justification sounds almost mystical: "There is ample evidence of the excellent performance of large building foundations in earthquakes. Tau is a manifestation of this."[7] The Appeal Board responded to criticism of Dr. Newmark by stating: "Simply in light of his repeated references to Dr. Yamahara's work, only a very crabbed reading of Dr. Newmark's testimony could assume that he did not appreciate tau in all its ramifications."[8] What seems less clear is whether either Board had any idea what it was talking about.

That there is some effect of this kind is plausible, even likely; that the effect is as large as claimed by the applicant and staff is merely conjecture. Here is the way the Commission's Office of Policy Evaluation describes the situation:

> "Based on the record, it appears that a phenomenon exists which at times limits the damage to structures in the near field during an earthquake. However, we have not been able to find an empirical or analytical approach which provides

> justification as to why the tau effect should be calculated in one specific manner over another. Analyzed or existing data are so sparse that the actual reason for the observed effect may still not have been recognized within the engineering community. Except for the judgment of Drs. Blume and Newmark, there is no evidence to demonstrate an ability to predict tau effects over a range of earthquake magnitudes, structural configurations, and site conditions."[9]

The fact is that the tau effect has not been used in any other nuclear plant analysis. To our knowledge, it has not been used in the design of any other large building.

Comparison of Response Spectra

With the changes and adjustments permitted by the Board it turns out that the post-Hosgri seismic response spectrum does not in all respects represent a more severe seismic standard than the one used before the discovery of the Hosgri fault. As the accompanying diagram illustrates, in the frequency range between 5 and 10 hertz (cycles per second), a range of particular interest in the analysis of the containment building surrounding the reactor, the two response spectra are quite close.[10] For part of this range, in fact, the old spectrum shows a higher response. In other words, for that part of the range the original design conditions were more demanding than the new ones imposed after the discovery of the Hosgri fault. This new

spectrum is the basis of the engineering reanalysis and ultimately determined the extent to which the containment was to be modified. Not surprisingly, in view of the above, only minor changes were required in this area.

Precedential Significance

The Commission decision not to take review, in effect, places the Commission's stamp of approval on the Appeal Board's decision. The Board's reasoning on the "tau effect", for example, may be cited in future cases when an applicant or licensee would otherwise have difficulty in complying with our regulations. Or the tau effect could be used to compensate for deficiencies discovered in the design of completed plants. This would be a significant weakening of past agency practice.

Altogether, we cannot escape the impression that the Commission is declining review not because the opinion is essentially sound, but because it is unsound and the prospect of reviewing it is so unsettling.

NOTES

1. We would note that one of the outside consultants retained by the Commission was also acting as a consultant on seismic issues to the applicant in the Summer case. We would have preferred to disqualify this expert in order to avoid any actual or apparent conflict of interest.

2. No hearings were held when the Hosgri fault was discovered. The persistence of litigation over these issues to this day suggests that it would have been wise policy, as well as good law, to reopen the construction permit hearing at that time.

3. The Commission's regulations, 10 CFR Part 100, Appendix A, define the "Safe Shutdown Earthquake" as being "that earthquake which is based upon an evaluation of the maximum earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material. It is that earthquake which produces the maximum vibratory ground motion for which certain structures, systems, and components are designed to remain functional."

   The specific structures, systems, and components which must remain functional are those which are necessary to assure: "(1) The integrity of the reactor coolant pressure boundary. (2) The capability to shut down the reactor and maintain it in a safe shutdown condition, or (3) The capability to prevent or mitigate the consequences of accidents which could result in potential off-site exposures comparable to the guideline exposures" of Part 100.

4. In the Matter of Pacific Gas and Electric Company (Diablo Canyon Nuclear Power Plant (Units 1 and 2)), 10 NRC 453 (1979).

5. Memorandum to the Commissioners from Forrest Remick, Subject: Diablo Canyon Design, dated November 12, 1981 with enclosure.

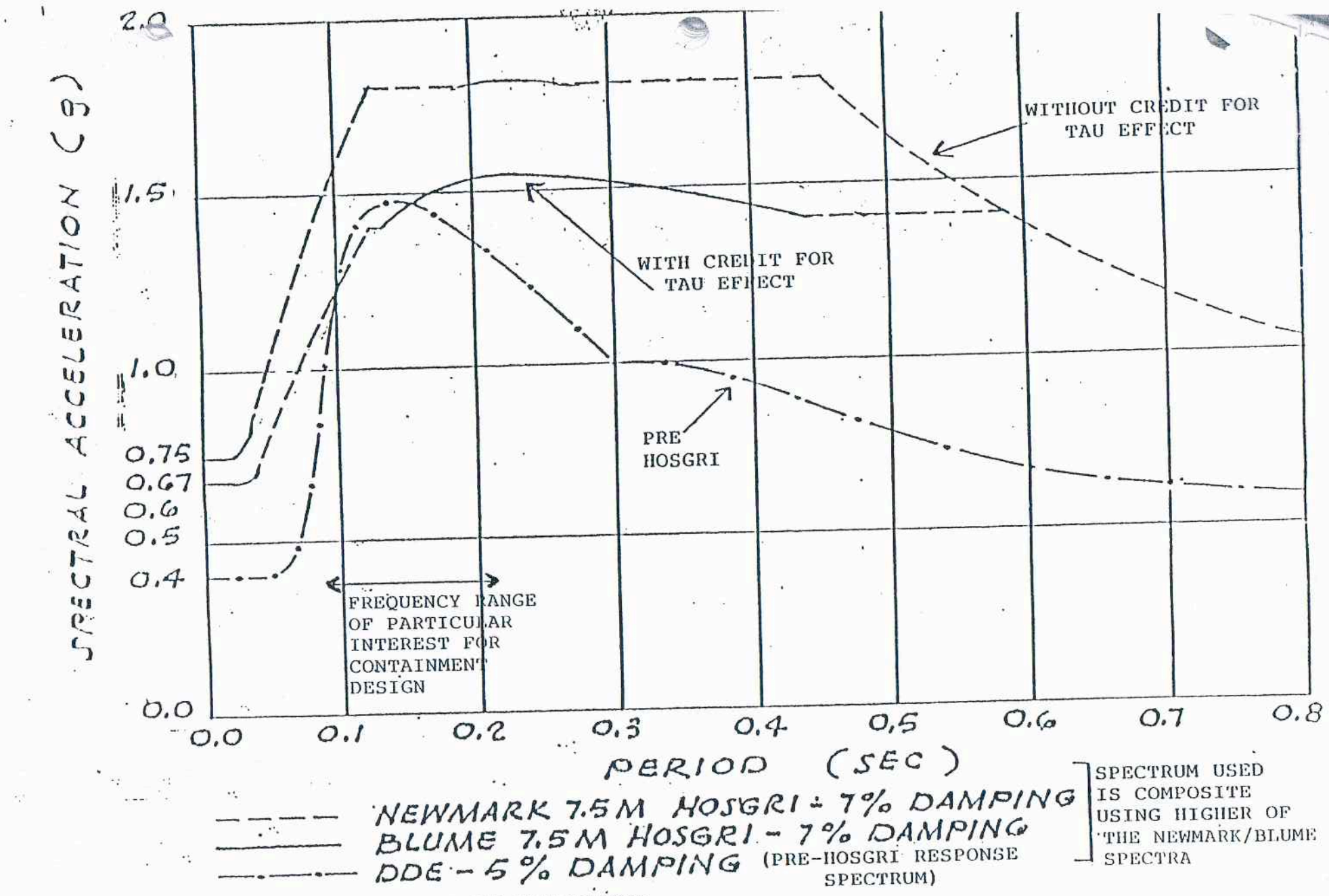
6. ALAB-644, p. 114, footnote 266.

7. In the Matter of Pacific Gas and Electric Company (Diablo Canyon Nuclear Power Plant (Units 1 and 2)), 10 NRC 453, 495 (1979).

8. ALAB-644, page 124.

9. Memorandum to the Commissioners from Forrest Remick, Subject: Diablo Canyon Design, dated November 12, 1981 with enclosure.

10. Seismic Evaluation for Postulated 7.5 M Hosgri Earthquake, Units 1 and 2 Diablo Canyon Site, figure 4-23.



DIABLO CANYON CONTAINMENT STRUCTURE

COMPARISON OF VARIOUS ELASTIC RESPONSE SPECTRA

Taken From: "Seismic Evaluation for Postulated 7.5 M Hosgri Earthquake, Units 1 & 2, Diablo Canyon Site"

FIGURE NO. 4-23