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ENCLOSURE

Response to questions concerning Relative Risk proposed in NRC letter of November 10, 1977...

(3-P)

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ATTORNEYS

December 21, 1977

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 & 2

Dear Mr. Stolz:

In support of our interim operating license application, this letter provides a response to question 4, parts a and b (relative risk), from your November 10, 1977 letter.

Responses to the other questions will follow according to the following schedule:

Earthquake Probabilities	12-30-77
Asymmetric Loads	1-6-78
Long Term Cooling	1-19-78

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 (40)
CC w/enc.: Service List

Answers to Questions Concerning Relative Risk Proposed in NRC Letter of November 10, 1977

Question

4a. The major conclusion of this study indicated on page 5 is that "for all cases analyzed, the ratio of risk during the interim license to the risk during the full term license is less than unity." Elaborate on this conclusion and whether it is equally valid for plant damage probability curves other than those assumed in Figure II of the report. Specifically, discuss various combinations of seismicity and failure probability curves that will produce a risk ratio of greater than one, and provide the bases, if any, for concluding that such cases are not significant. For example, discuss the combination of the Case C (for .4g nominal design) with Case A (for .75g nominal design). Since plant failure is treated conservatively for both 0.4g and 0.75g designs, the risk computed for each case is likely the upper bound. However, taking the ratio of two upper bounds reveals little about the ratio of the true risks. Discuss possible means to alleviate this concern including specific proposals for conducting an adequate number of case-bounding studies with unconservative assumptions for both the plant failure and seismicity hazard probability curves.

Answer

As stated in the study, we concluded that "the calculated risk associated with the proposed interim license period would be significantly less than that calculated for the full term of plant operation. In addition, it can be concluded that this general conclusion would not be changed by the consideration of a wide variety of earthquake probability curves or plant response curves." We also concluded that "if the plant response is not significantly different for the plant nominally designed for 0.4g or 0.75g, the ratios of interim risk to full term risk are even lower than the values given in Table II. Other shapes of plant response using convex, concave or "s" shaped curves can also be assumed and easily represented by combinations of the straight lines used in this analysis. The use of such curves would not result in different conclusions." As stated, we believe the conclusion is "equally valid for plant damage probability curves other than those assumed in Figure II of the report."

We do not believe that an arbitrary search for mathematically possible combinations of curves, which would yield a "risk ratio" greater than one, is an appropriate way for us to approach the risk assessment. The example suggested in the question combines totally different shapes of conceptual risk curves. We believe that taking a ratio of the results of this combination is technically indefensible. To date, we have not found any risk ratio which exceeds unity with any reasonable representation of plant response. Even if such a case were identified, we cannot see how it could become of such importance as to overturn the general conclusions concerning the risk ratio.

We note also that in the recent study conducted by Newmark and Ang,(1) the following conclusions were reached:

1. "The two-year damage probabilities of the existing plant, in the presence of the Hosgri fault, are consistently lower (by a factor of about 2 to 7) than the corresponding thirty-year damage probabilities if the plant of the Hosgri fault did not exist.

2. If the Plant were retrofitted for an SSE of 0.75g, and assuming that the same safety factors can be approximately maintained for the upgraded plant, the thirty-year damage probabilities of the upgraded plant, in the presence of the Hosgri fault, are also consistently lower (by a factor of about 2 to 3) than the original thirty-year damage probabilities considered acceptable during the design of the plant.

In light of the above observations, it can be concluded that for an interim period of two years, the safety of the plant would not be compromised relative to that originally envisaged and accepted for its design; that is, the risk associated with the operation of the existing plant for an interim period of two years will be lower than the risk initially accepted (based on the premise of no Hosgri fault) for a thirty-year life. Moreover, by retrofitting and upgrading the plant for an SSE of 0.75g, the risk of the retrofitted plant over a period of thirty years will also be less than that originally accepted for its design; assuming, of course, that approximately the same safety factors can be maintained for the retrofitted plant."

Reference

1. Ang, H-S., and Newmark, N. M., "A Probabilistic Seismic Safety Assessment of the Diablo Canyon Nuclear Power Plant," Report to the U.S. Nuclear Regulatory Commission, November 1977.

Question

4b. Discuss the adequacy of using a simple one-parameter (acceleration) to define the seismic hazard and the failure probability in the evaluation of relative risks, considering these are a function of many parameters (e.g., ground acceleration, frequency content of ground motion, damping, variability of seismic capacity of various elements, etc.). Also, address simplistic means, if any, to account for these parameters in the relative risk analysis model.

Answer

During the initial phases of the seismic risk study[1] conducted for Diablo Canyon, discussions were held among PG&E engineers and our consultants on the difficulties and limitations involved in characterizing the seismic input probabilities by using peak acceleration only. We were aware that because the study was representing component and system response at a much greater level of detail than had been done in previous studies, the frequency content of the input, as well as many other variables, would have to be considered.

The manner of consideration could be explicit or implicit. With explicit consideration, we would need to develop seismic probability of exceedence curves for many frequencies, as well as numbers of cycles, component and system responses, and other factors. Such a process was unanimously regarded as entirely too complex, well beyond the state-of-the-art, impractical, unnecessary, and, in fact, would be very likely to yield confusing and deceptive results. It was decided that implicit consideration of these factors, with peak acceleration as the focal probabilistic parameter, was a superior and more practical approach. On this basis, the frequency content and other factors were considered during the selection and development of the component and system failure rate data, as it relates to the stress analysis and equipment qualification data.

It should be noted also that as a part of the answer to questions proposed earlier by the staff,[2] an extensive sensitivity study was done to determine the degree of influence of various failure rates on the overall seismic risk. In this study, very significant degradation in plant response probabilities was shown to cause only moderate increase in overall risk.

With regard to how to handle these complexities in the context of the simpler relative risk models, we believe it is still best to use the peak acceleration as the focal parameter. This is basically why we conducted the detailed analysis reported in Reference 1. The best plant response curves to use for relative risk would be the plant response curves resulting from this analysis. As we stated in the response to the previous question, the use of these response curves (which are similar for the 0.4g and 0.75g designs) result in an even lower risk ratio. It would not add accuracy to attempt to represent the seismic event by a complex set of three or four probabilistic curves, while leaving the plant to be modeled by one or two black boxes.

Reference

1. "Analysis of the Risk to the Public from Possible Damage to the Diablo Canyon Nuclear Power Station from Seismic Events," Amendment 52 to the FSAR for Diablo Canyon, Dockets Nos. 50-275-OL and 50-323-OL, August 25, 1977.

2. Supplementary material submitted by the Pacific Gas and Electric Company in response to NRC questions proposed at the October 6, 1977, review meeting (submittal date October 14, 1977).