



BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.

Upton, Long Island, New York 11973

(516) 282-7204
FTS 666

Department of Nuclear Energy
Building 130

Enclosure

May 27, 1987

Mr. Nilesh Chokshi
Probabilistic Risk Analysis Branch
Division of Reactor Accident Analysis
Office of Nuclear Regulatory Research
MS 244, Room 230
Phillips Building
7920 Norfolk Avenue
Bethesda, MD 20814

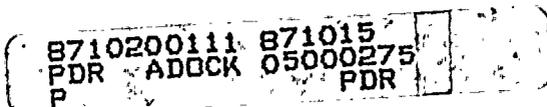
Dear Mr. Chokshi:

Re: FIN A-3847

This letter is to provide you with a summary of my thoughts and impressions following the February Workshop on the Diablo Canyon plants. BNL's general interests, in accordance with our contract, fall into two basic categories; one category being the overall development of the Diablo Canyon PRA, the other being more specific and centered on the seismic aspects of the PG&E study.

In terms of the advancement of the seismic aspects of the study, I will defer on any specific comments to our lead consultant, Dr. Michael Bohn. Dr. Bohn's comments are attached and are in the form of a letter addressed to myself. I would only add that I share Dr. Bohn's impression of the favorable nature of the effort and analyses being performed.

The PRA itself would also seem to be progressing nicely. Based upon the information presented at the Workshop, it appears that our planned review of the support state modelling is both timely and appropriate. As we stated during the Workshop, two other items surfaced that would also appear prudent to be factored into our review at this time. The first is the updating of the generic data base to reflect Diablo Canyon-specific experience. The second is the new approach being utilized by PLG to augment the event trees to reflect certain plant conditions or states prior to introducing the initiating events into the event trees.





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It is also clear at the time of this writing that the full scope of review effort we had planned for this fiscal year is probably not achievable. This situation reflects the fact that the support state models are now not expected to be submitted for review until July, and we had planned to begin an informal review of this material in the March-April time frame.

The current status of our review effort can be summarized as follows. The seismic areas currently have sufficient documentation to allow a meaningful review to proceed. The BNL PRA review team has been assembled, is expending some effort in getting up to speed on the project, and awaits the receipt of the documentation concerning support state modelling (etc.) to begin the detailed review.

Sincerely,

Tsong-Lun Chu for R. Fitzpatrick

R. G. Fitzpatrick
Group Leader, Risk Evaluation Group

RGF/csc

Attachment

cc: R. A. Bari (w/o attachment)
W. Y. Kato (w/o ")
W. T. Pratt (w/o ")



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Sandia National Laboratories

Albuquerque, New Mexico 87185

March 4, 1987

R. G. Fitzpatrick
Risk Evaluation Group
Brookhaven National Laboratory
Upton, Long Island, New York 11973

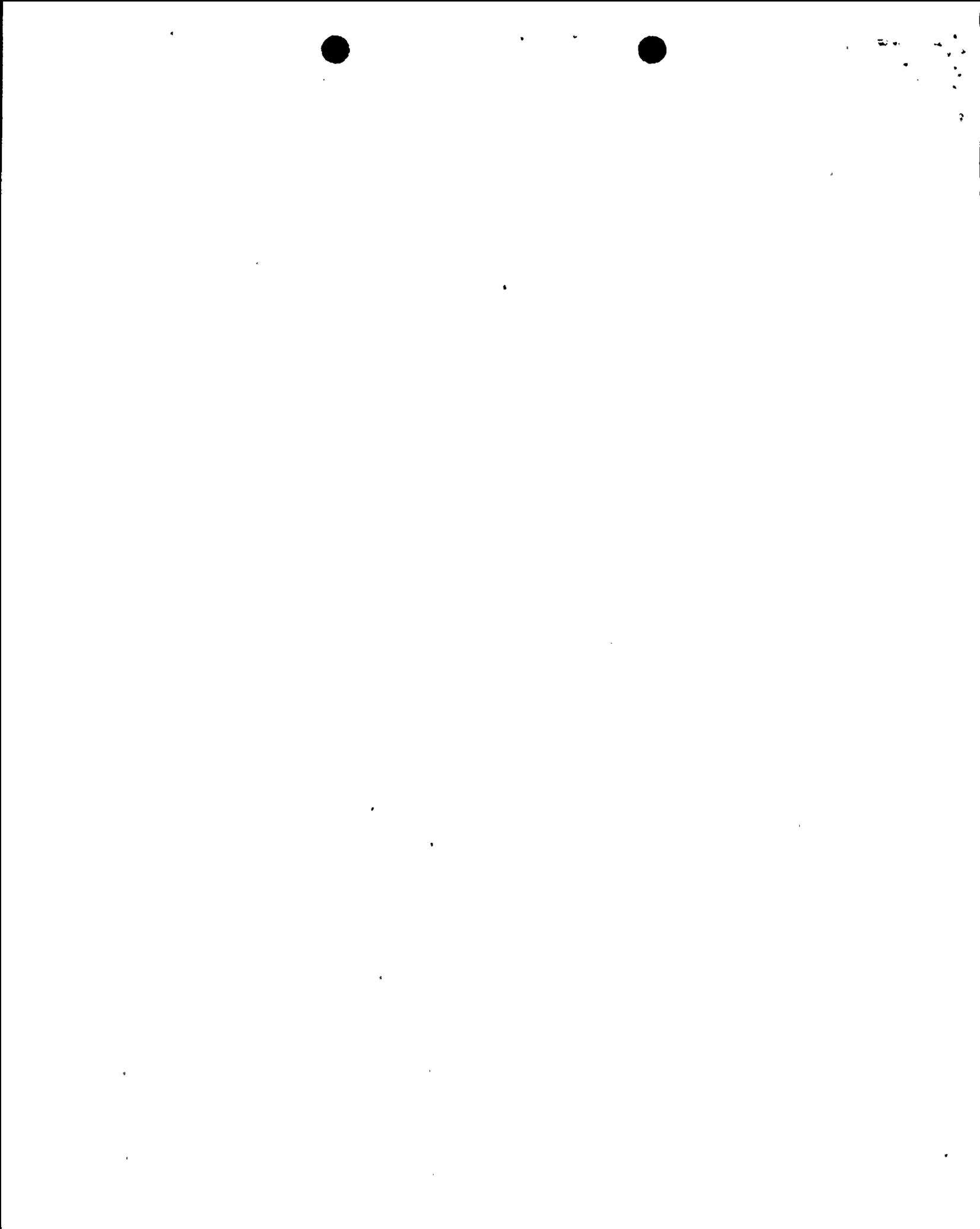
Subject: Comments on the Diablo Canyon Seismic Probabilistic Risk Assessment Based on the Diablo Canyon Long-Term Seismic Program NRC/PG and E Workshop on Seismic Probabilistic Risk Assessment, February 17 and 18, 1987

Dear Bob:

The methodology being applied in the Diablo Canyon Seismic Probabilistic Risk Assessment (PRA) is similar to that of other commercial seismic PRAs but with methodological improvements and benchmarking of key elements in the analysis. Similarities also exist with the USNRC Seismic Safety Margins Research program (SSMRP) detailed and simplified methodologies. As most people recognize, these methodologies were not developed independently and, hence, the close correlation between them is expected. The Factor of Safety approach is being utilized, i.e., factors of safety are developed to account for conservatism and unconservatism in the response and capacity determinations of structures and components. Our overall impression of the methodology being utilized, its improvements and benchmarking, is very favorable based on the subject workshop. Specific comments on selected topics follow.

Seismic Hazard Curve/Fragility Parameter

The use of an average spectral acceleration (average over a frequency range) as the seismic hazard curve parameter is a relatively new development. The benefits of switching from peak or effective peak ground acceleration to average spectral acceleration are not entirely obvious and, apparently, are principally in the elimination of "double-counting" of variability in spectral acceleration and its allocation to the seismic hazard curve development and the fragility analysis. This allocation and treatment of variability (randomness) and uncertainty (modeling uncertainty) in the hazard curve and fragility analysis requires evaluation. In addition, the mechanism of using average spectral acceleration of the ground motion as the fragility parameter for structures, structural elements, and components needs to be reviewed and understood and the associated uncertainties properly taken into account.



Nonlinear Structural Analysis of the Turbine Building

Performing nonlinear structural analysis of the turbine building as a benchmarking tool for the fragility methodology is a sensitivity study which has long been needed. There are many positive aspects of the study as presented -- multiple time history analyses, inclusion of variability in physical parameters, etc. The correlation between the results of the nonlinear analyses and the factors of safety is surprisingly good. These results will require detailed review with emphasis on their applicability to other Diablo Canyon structures and their implication on other response quantities such as in-structure response spectra.

Soil-Structure Interaction Effects

Impressions from the workshop suggest that SSI effects may be significant in terms of response (or demand) predictions for the structures of interest even though the Diablo Canyon site is rock. The anticipated effects are due to incoherence of ground motion and wave scattering effects. If, as anticipated, these effects are significant, a review of their development and their incorporation into the seismic PRA is necessary. In particular, the definition and treatment of uncertainty will be important. Also, if inclusion of SSI effects in building response predictions is done through approximate factors, their development and associated uncertainty requires review and evaluation. Finally, any change in SSI effects with excitation level needs to be evaluated.

Median In-Structure Response Spectra

The explicit development of in-structure response spectra accounting for variability in input motion and the definition of system dynamic characteristics has been done for many SSMRP type analyses in the past and has been found to be extremely valuable in defining the seismic demand for components housed in the structure. This effort for Diablo Canyon is a good one and represents an improvement over commercial seismic PRA methodology. The workshop discussion noted that this analysis will be done for a linear fixed-base structure model. Consequently, the effects of SSI and nonlinear structural behavior on in-structure response spectra will need to be added.

Impact and High Frequency Response

In the analysis of the turbine building, both nonlinear shear wall constitutive models and gap elements were utilized. In conversations with Bob Kennedy, it was mentioned that the



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lateral response was dominated by impact across these (three-inch wide) gaps. The net effect of this is to give rise to high frequency accelerations (above the range of normal earthquake accelerations), with a significant amount of energy in the high frequency range. While this will not, in general, affect the structures, it can affect crucial instrumentation or functional failures of certain equipment. The potential effects of such high frequency impact accelerations will have to be examined.

These comments reflect our impressions of the workshop. Please feel free to incorporate them into your response to NRC as appropriate. Again, our overall impression was very favorable in terms of the effort and analyses being performed. If you should have any questions, please contact me.

Sincerely,



Dr. Michael P. Bohn
Reactor Systems Safety Analysis
Division 6412

MPB:6412:ep

Copy to:
NRC N. Chokshi

