UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

July 14, 1978

Honorable Joseph M. Hendrie
Chairman
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: REPORT ON DIABLO CANYON NUCLEAR POWER STATION UNITS 1 AND 2

Dear Dr. Hendrie:

During its 219th meeting, July 6-8, 1978, the Advisory Committee on Reactor Safeguards completed its review of the application of the Pacific Gas and Electric Company for authorization to operate the Diablo Canyon Nuclear Power Station Units 1 and 2. This project has been considered at Subcommittee meetings and site visits as follows: September 12, 1974 in Washington, DC; February 18-19, 1975 in San Luis Obispo, CA; February 19, 1975 at the site; May 23, 1975 in Los Angeles, CA; May 21, 1976 in San Luis Obispo; June 25-26, 1976 in San Luis Obispo; October 11, 1976 in Los Angeles; June 21-23, 1977 in Los Angeles; August 2, 1977 in Des Plaines, IL; June 14-15, in Washington, DC; and June 21 in Washington, DC. The Committee reported previously on its partial reviews of this application in its letters of June 12, 1975 and August 19, 1977. During its review, the Committee had the benefit of discussions with representatives and consultants of the Pacific Gas and Electric Company, the Westinghouse Electric Corporation, and the Nuclear Regulatory Commission (NRC) Staff, as well as comments from members of the public. The Committee also had the benefit of the documents listed.

At the time the Committee made its partial review of this application, as reported in its letter of August 19, 1977, the NRC Staff had substantially completed its review of those matters not related to the seismic design and capability of the plant. Those items remaining outstanding were to be resolved in a manner satisfactory to the NRC Staff. Progress on the resolution of these items has been reviewed and all items have been found either resolved or near resolution.

Since the Committee last reviewed and reported on this application, several additional nonseismic matters of concern to the NRC Staff have arisen, and some of these are not yet completely resolved. These include: operation of the containment purge system when the reactor is at power, possible undesirable interactions between the seismic scram circuits and the reactor protection system, correction of an error in the calculation of zirconium-water reaction in the Westinghouse emergency core

cooling system evaluation model, and adequacy of the reactor vessel material surveillance specimens. The status of each of these items has been reviewed and the Committee recommends that they be resolved in a manner satisfactory to the NRC Staff.

A major problem related to the Diablo Canyon Nuclear Power Station has resulted from the discovery, after the plant was under construction, of a major fault about 6 km offshore from the plant. Following extensive investigations by the Applicant, the NRC Staff, and the U.S. Geological Survey, the Staff accepted the recommendation of the Geological Survey that this fault, the Hosgri fault, was capable of generating an earthquake having a magnitude as great as 7.5 on the Richter scale. The Staff then developed seismic design bases in the form of seismic response spectra appropriate to an earthquake of this magnitude at this distance. Since these new seismic design bases were considerably more severe than those for which the plant was originally designed, the NRC Staff has required the Applicant to reevaluate the safety of the plant for this larger earthquake.

The Applicant has complied with the Staff's requirement and has carried out extensive reanalyses of the structures and components in accordance with the new seismic design bases and criteria. In those cases for which the plant, as designed and constructed, did not meet the new criteria, structural modifications have been or are being made. In addition, extensive tests have been carried out on mechanical and electrical equipment in the plant to qualify it for the excitations produced by the larger postulated Hosgri event.

The Applicant's analyses and tests related to the reevaluation of the structural and mechanical components for the Hosgri event have been subjected to an unprecedentedly intensive and comprehensive review by the NRC Staff and their consultants. This review involved numerous meetings between the Staff and the Applicant to review and audit, in considerable detail, the procedures and criteria used by the Applicant in the seismic reevaluation of the plant structures and components.

Since there are expected to be significant differences between the nature of the ground motions close to a large earthquake and that at greater distances, to which most available data apply, the Staff relied heavily on the experience and judgment of its consultant, N. M. Newmark, an acknowledged expert in the field of earthquake engineering and structural design. On his advice, an effective zero-period acceleration of 0.75g was used to determine the free-field response spectra to be used in engineering analyses. These spectra were then reduced by varying amounts to obtain spectra for those structures in the plant having foundations extending over large areas. This reduction for the effects of building size is also based largely on judgment and experience rather than on extensive observations or analyses and has not heretofore been applied in the design of nuclear power plants.

The seismic design criteria proposed by the Staff permitted the use of damping factors for structures in accordance with Regulatory Guide 1.61 in place of the lower, and thus more conservative, values used by the Applicant in the original design. The Staff also permitted the use of as-built dimensions and masses, and material strengths determined from tests during construction, rather than the more conservative values used in the original design.

It is evident from the foregoing that the design bases and criteria utilized in the seismic reevaluation of the Diablo Canyon Station for the postulated Hosgri event are in certain cases less conservative than those that would be used for an original design. The Committee believes, however, that there are offsetting factors that lead to acceptance of these bases and criteria for an already completed plant. They include: (1) the fact that the Committee's consultants believe that the choice of magnitude 7.5 for the postulated Hosgri event is relatively more conservative than the values considered acceptable for other plants; (2) because of the extent and depth of the Staff's review of the Applicant's seismic reevaluation, the likelihood of an undetected error in the seismic analyses or design is greatly reduced; and (3) the fact that the population density around the Diablo Canyon site is low. For these reasons, the Committee believes that, without endorsing all details of the NRC seismic design bases and criteria, the use of the Staff approach leads to an acceptable level of safety in this instance.

As mentioned previously, the Applicant has undertaken a comprehensive reevaluation of all safety-related structures and components to determine their ability to withstand the postulated Hosgri event. As a result of these studies, modifications to the plant have been required and are being made. The NRC Staff has audited the criteria and procedures used by the Applicant in connection with the reevaluation and with the design of the modifications. The Committee recommends that the remaining outstanding items relating to reevaluation and modification of the plant should be resolved in a manner satisfactory to the NRC Staff.

The Applicant has made tests, both in place and in the laboratory, to demonstrate that various mechanical components and electrical systems and instrumentation would remain functional if subjected to the postulated Hosgri earthquake. The NRC Staff has reviewed the results of the tests that have been made and has required additional tests or analyses in some instances and additional information in others. The Committee believes that the approach taken by the Staff in this matter has been appropriate and that the remaining outstanding items should be resolved in a manner satisfactory to the NRC Staff.

At the request of the Committee, the Applicant has made a study to determine the consequences of a failure of any one of the snubbers intended to restrain the motion of components or piping during an earthquake. For the reactor coolant loops, a deterministic study was made, with acceptable results. For systems in the balance of plant, the Applicant made a probabilistic assessment of snubber failures and the consequences thereof. The assumptions on which this study was based have not been found fully acceptable by the NRC Staff or the Committee. The Committee and the Staff believe, however, that the results of the study have lessened their concerns and that this matter should be considered generic to all plants, to be resolved in a timely manner.

The NRC Staff has decided that the requirements of Branch Technical Position RSB 5-1 should be met for the Diablo Canyon Station. This position requires demonstration that the plant can be brought to the cold shutdown condition using only safety-grade equipment. The Staff review of the ability of the plant to meet this requirement is essentially complete. The remaining questions should be resolved in a manner satisfactory to the NRC Staff.

The Applicant has elected to use an acceleration of 0.20g to define the Operating Basis Earthquake. If accelerations greater than this value are observed, the plant will be shut down and inspected for possible damage. The Committee considers this value suitably low as a basis for determining when the plant should be shut down following an earthquake.

The Applicant has provided a seismic scram system for the Diablo Canyon Station. The occurrence of accelerations greater than 0.4g in any direction will automatically shut down the reactor. The Committee believes that a seismic scram set at a substantial fraction of the Safe Shutdown Earthquake value is a desirable feature, and finds the proposed setting acceptable.

Those generic problems considered relevant to the Diablo Canyon Station are listed in the Committee's letter of August 19, 1977 and are described in the Committee's Report No. 5 on Generic Items, dated February 24, 1977. Of those items listed, the following are now considered to be resolved for the Diablo Canyon Station: II-2, II-4, II-5A (Loose parts monitor), II-9, IIA-3, IIA-5, IIB-2, IIC-2, IIC-4. The remaining problems, together with Item IIC-6 from the Committee's Report No. 6 on Generic Items, dated November 15, 1977, should be dealt with by the Staff and the Applicant as solutions are found.

The ACRS notes that, for distances less than 10 km from the earthquake source, there are currently no strong motion data for shocks larger than magnitude 6 and few reliable data for shocks of magnitude 5 and 6. Also, the theory and analyses of earthquake and seismic wave generation, of seismic wave transmission and attenuation, and of soil-structure interaction are in a state of active development. The Committee recommends that the seismic design of Diablo Canyon be reevaluated in about ten years taking into account applicable new information.

The Advisory Committee on Reactor Safeguards believes that, if due consideration is given to the items mentioned above, and subject to satisfactory completion of construction, plant modifications, and preoperational testing, there is reasonable assurance that the Diablo Canyon Nuclear Power Station Units 1 and 2 can be operated at power levels up to 3338 and 3411 MWt for Units 1 and 2, respectively, without undue risk to the health and safety of the public.

Sincerely yours,

Stephen Lawroski

Stephen Lawroski
Chairman

References

1. Final Safety Analysis Report (FSAR) for Diablo Canyon Nuclear Power Station Units 1 and 2, and Amendments 1-63 to the FSAR.

2. Safety Evaluation Report dated October 16, 1974 and Supplements 1-7 dated January 31, 1975, May 9, 1975, September 18, 1975, May 1976, September 1976, July 14, 1977 and May 26, 1978 respectively.

3. USGS Circular 672. Ground Motion Values for Use in the Seismic Design of the Trans-Alaska Pipeline System.

4. USGS Open File Report 75-134. Seismicity of the Central California Coastal Region.

5. Pacific Gas and Electric Company (PG&E) letters to the NRC as follows:

   a. Emergency plans dated March 21, 1974, June 18, 1976, October 12, 1977 and February 8, 1978
   b. Preoperational testing of ECCS dated July 12, 1974
   c. ECCS analysis dated December 3, 1974, June 10, 1977, May 16, 1978

d. Seismic analysis and/or requalification dated December 27, 1974, July 29, 1975, March 2, 1976, January 27, 1977, October 4, 1977, November 2, 1977, December 21, 1977, January 5, 1978, February 14, 1978, April 17 & 26, 1978, May 2 & 26, 1978
e. Steam generators dated April 7, 1975, February 14, 1978, May 11, 1978
f. Reactor vessel supports dated January 13, 1976, July 20, 1976, February 10, 1978
g. Geophysical survey records dated December 8 & 16, 1975, March 2 & 26, 1976
h. Protection systems noise tests dated November 24, 1975, March 23, 1976
i. Containment testing dated January 8, 1976, March 23, 1976, July 29, 1976, December 1, 1977
j. Anticipated transients without scram dated September 30, 1976
k. Environmental qualification of components dated January 19, 1978, February 10 & 15, 1978, May 3, 1978
l. Performance during grid undervoltage conditions dated March 20, 1978
m. Inservice inspection program dated October 10, 1977
n. Temperature monitoring system dated December 5, 1977
o. Containment spray additives dated January 9, 1978
p. Stress evaluation of piping systems dated January 24, 1978, March 7, 1978, April 12, 1978
q. Diesel generator operating status indications dated December 30, 1977
r. Fire protection systems dated February 6, 1978
s. Seismic scram dated February 21, 1978, April 17, 1978
t. Post Accident Monitoring Instrumentation dated June 13, 1978
u. Responses to SER comments dated June 30, 1978, July 6, 1978
v. Turbine-generator stop valves dated April 11 & 26, 1978
w. Reactor vessel internals dated February 22, 1978, April 11, 1978
x. Operating Basis Earthquake dated April 11, 1978
y. Containment penetrations dated June 6, 1978
z. Steam line break inside containment dated September 15, 1977
aa. Containment isolation dated July 8, 1977
bb. Security Plan (Proprietary) dated July 22, 1977
cc. Systems for Safe shutdown dated April 17, 1978, May 2, 1978

6. Statements from interested members of the public as follows:

a. Kingsburg District Chamber of Commerce dated August 10, 1977
b. Mr. H. Weber dated July 6, 16, 30, 1976, September 20, 1976, October 11, 1976.
c. Donna J. Cuffiero dated September 27, 1977

d. J. R. Bakalian, Executive Director, Nuclear Moratorium Task Force dated June 8, 1978
e. D. S. Fleischaker, Attorney For Intervenors dated March 29, 1978, April 11, 1978, June 9, 1978
f. Sandra A. Silver dated February 10, 1975
g. E. E. Apfelberg dated February 11, 1974
h. R. Nader dated April 8, 1976 w/enclosure
i. G. O'Ryan (Citizens Against Pollution) dated June 17, 1976
j. J. N. Brune dated November 3, 1976, June 23, 1977
k. Center for Law in the Public Interest dated November 19, 1976, March 28, 1977, June 23, 1977
l. K. J. Husemeyer dated March 5, 1977
m. R. B. Hubbard dated March 10, 1977, April 27, 1977, June 23 & 30, 1977, July 8 & 12, 1977, August 2, 12, 25, 30, 1977, October 10, 1977
n. R. R. Curry dated June 23, 1977
o. J. Klugewiz/K. Kempton dated June 23, 1977