H. Rood
13E16

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JAN 18 1991

MEMORANDUM FOR: Goutam Bagchi, Chief
Structural and Geosciences Branch
Division of Engineering Technology

THRU: David C. Jeng, Section Chief
Structural and Civil Engineering Section
Structural and Geosciences Branch
Division of Engineering Technology

FROM: Yong Kim, Structural Engineer
Structural and Geosciences Branch
Division of Engineering Technology

SUBJECT: AUDIT FOR DIABLO CANYON LONG TERM SEISMIC PROGRAM

On December 11-12, 1990, Harry Rood, Project Manager in NRR/PD5, Goutam Bagchi, Chief, Raman Pichumani, Geotechnical Engineer and Yong Kim, Structural Engineer in NRR/DET, ESGB, and Nilesh Chokshi, Section Chief in RES/DE, SSEB visited Pacific Gas & Electric (PG&E) Company in San Francisco to audit the PG&E's additional deterministic evaluation as a part of the Long Term Seismic Program (LTSP) on the Diablo Canyon Power Plant (DCPP).

At a brief meeting with the licensee's staff and its consultants at 8:15 am on Tuesday, December 11, 1990, the NRC staff outlined the objectives and specified the areas of the audit: structures (containment, auxiliary building and turbine building) and equipment (containment fan cooler, fuel handling building crane and diesel generator control cabinet). A list of attendees at the meeting is enclosed (Enclosure 1).

After the NRC staff's brief outline, the licensee's consultant, Bimal Sarkar from Bechtel, presented an overview of additional deterministic evaluation, and described the scope of the evaluation. The PG&E's civil engineer, David Ovadia, briefly described the following aspects: (1) plant response, (2) Conservative-Deterministic-Failure-Margin (CDFM) criteria, (3) capacity evaluation, (4) margin assessment, (5) comparison between CDFM and High-Confidence-of-Low-Probability-of-Failures (HCLPF) derived from the fragility analysis, and (6) conclusions of the study. The licensee showed that the results of the CDFM method agreed well with the HCLPF results of the fragility analysis method performed previously for the LTSP Probabilistic Risk Assessment (PRA) study, and concluded that there existed an adequate safety margin in the structures and equipment of the DCPP. A copy of the overview is enclosed (Enclosure 2).

After the licensee's presentation, discussions followed on the masonry walls of the DCPP. The licensee indicated its decision to modify all 123 of the safety related masonry walls. The NRC staff requested additional information regarding the licensee's plans in selecting design criteria, identifying

CONTACT: Y. Kim, ESGB
492-0729

critical masonry walls and scheduling repairs. The licensee responded that they were fully aware of the NRC's concerns and would provide information in the afternoon audit.

The actual audit on the licensee's computational work began at 11:00 am on December 11, 1990. The licensee provided a calculation log (Enclosure 3) of the additional deterministic study and the licensee's staff was ready and available to answer the NRC staff's questions if there were any. First, the NRC staff audited the following subjects: (1) adjustment factors for ground motion incoherence, (2) adjustment factors for conservatisms in artificial time histories, (3) adjustment factors for mass differences in Units 1 and 2 of turbine building, and (4) definitions of capacity/demand ratios and seismic margins. No issues were identified during the morning audit.

At 1:00 pm, the PG&E's consultant, Robert Kennedy from RPK Structural Mechanics Consulting, presented his draft calculation of the masonry wall design using a nonlinear time history approach, which resulted in additional design margin beyond that predicted by the Uniform Building Code design methodology. The NRC staff suggested that the licensee submit a formal proposal for reevaluation of Diablo Canyon masonry walls.

From 3:00 to 5:00 pm on Tuesday, December 11 and from 7:45 to 9:40 am on Wednesday, December 12, 1990, the NRC staff audited the following subjects: (1) containment evaluation, (2) auxiliary building evaluation, and (3) turbine building evaluation. During the audit, Goutam Bagchi raised a concern related to the validity of the test data used for the containment evaluation. The issue was related to the part that the connection details used in test differ significantly from that used at the Diablo Canyon containment. This difference may require evaluation of an additional failure mode. The NRC staff instructed the licensee to perform an evaluation and submit the results if the overall margin becomes invalidated by the new conclusions of the study. No additional issues were identified at the meeting.

At 9:50 am on December 12, 1990, the PG&E staff presented an analysis of the fuel handling building crane. A copy of the slides is enclosed (Enclosure 4). The analysis considered two cases (loaded and unloaded cases), and was performed with a crane subjected to vertical ground motion. Linear, nonlinear and energy balance methods were used for both analyses. The results of the study indicated that a substantial margin existed in the fuel handling building crane. The NRC staff raised a concern of CDFM capacity of the crane due to horizontal ground motion. The licensee responded to the concern that they considered both vertical and horizontal ground motions during the course of the study, and found that the vertical response was the dominant effect. No issues were identified during the audit of fuel handling building crane.

Two presentations for equipment were made by the licensee. The licensee's consultant, Thomas Kipp of EQE Engineering, presented deterministic margin analysis of the containment fan cooler at 11:00 am and Mohsin Khan of PG&E presented finite element analysis as well as experimental study of diesel

generator control panel including relays at 1:00 pm on December 12, 1990. A copy of the slides is enclosed (Enclosure 5). The study showed that there existed a substantial margin for the containment fan cooler and the diesel generator control panel of DCPP. No issues were identified during the audit of calculations on equipment evaluation.

After having a caucus at 3:20 pm, the NRC staff held an exit meeting with the licensee staff at 4:00 pm of December 12, 1990. A list of attendees at the meeting is enclosed (Enclosure 6). On behalf of the NRC staff, Goutam Bagchi discussed the audit findings and comments on the two-day audit, and they are summarized as follows:

(1) the licensee performed well on reassessment of the Diablo Canyon power block structures and selected components when subjected to the ground motions associated with the maximum magnitude earthquake on the Hosgri fault using the CDFM approach;

(2) no issues were identified during the audit except that the licensee will update and docket the CDFM reevaluation of the shell and interior structures of the containment if the results of the reevaluation alter the conclusions on the margin;

(3) the NRC staff indicated that it will carefully review any proposed criteria for modification of the masonry walls including prioritization and schedule; and

(4) the NRC staff asked and PG&E agreed to submit an addendum to the LTSP final report including a comprehensive summary of the additions/modifications made for each element of the LTSP as a result of the NRC staff review. The PG&E will submit a perspective summary of the lessons learned from the LTSP by each one of the PG&E research teams.

The licensee expressed their appreciation to the NRC staff's intensive efforts during the two-day audit, and said that they would submit the information according to the NRC staff's requests. The licensee also stated that they gained further understanding of the response behavior of Diablo Canyon structures and components as a result of the additional seismic analysis work and reassessment of key plant structural elements.

The audit for the additional deterministic evaluation of LTSP on DCPP ended at 4:45 pm on December 12, 1990.

Yong Kim, Structural Engineer
Structural and Geosciences Branch
Division of Engineering Technology

Enclosures: As stated

cc: w/enclosures
J. Richardson
L. Shao
B. D. Liaw
A. Murphy
M. Cunningham
R. Rothman