July 22, 1998

MEMORANDUM TO: William H. Bateman, Director
Project Directorate IV-2
Division of Reactor Projects III/IV

FROM: Goutam Bagchi, Chief
Civil Engineering and Geosciences Branch
Division of Engineering, NRR

SUBJECT: ECGB INPUT FOR SAFETY EVALUATION OF PG&E'S REQUEST FOR LICENSE AMENDMENT NO. 97-11 (AUXILIARY SALTWATER SYSTEM PIPING BYPASS PROJECT, UNRESOLVED SAFETY QUESTION)

Plant Name: Diablo Canyon Power Plant (DCPP), Units 1 and 2
Licensee: Pacific Gas & Electric Company (PG&E)
Docket Nos. 50-275 and 50-323
Review Status: Completed
TAC Nos. M97914 and M97915

The Civil Engineering and Geosciences Branch has completed its review of PG&E's submittals of August 26, 1997 and October 14, 1997 for license amendment No. 97-11 related to the Auxiliary Saltwater (ASW) system piping bypass project. The attached safety evaluation report (SER) input is with respect to the civil engineering and geosciences aspects of the licensee's submittal. It deals with the unreviewed safety question pertaining to the soil liquefaction issue, and related topics such as slope stability in the vicinity of the ASW piping bypass.

In addition, this SER input covers the geotechnical parameters such as the seismically-induced settlements used by the Mechanical Engineering Branch in its evaluation of the ASW piping analysis.

Attachment: As stated

DISTRIBUTION:
File Center
ECGB RF
GLainas
JStrosnider
MHartzman

DOCUMENT NAME: g:\pichuman|dcaswpip.ser PA 11B1 TAC # M97914 & M97915
To receive a copy of this document, indicate in the box C=Copy w/o attachment/enclosure E=Copy with attachment/enclosure N = No copy

OFFICE	DE:ECGB	E	DE:ECGB		DE:ECGB	C	DE:ECGB	
NAME	RPichumani		ALowery		RRothman		GBagchi	
DATE	7/20/98		7/17/98		7/20/98		7/21/98	

OFFICIAL RECORD COPY

DF01

July 22, 1998

MEMORANDUM TO: William H. Bateman, Director
Project Directorate IV-2
Division of Reactor Projects III/IV

FROM: Goutam Bagchi, Chief
Civil Engineering and Geosciences Branch
Division of Engineering, NRR

SUBJECT: ECGB INPUT FOR SAFETY EVALUATION OF PG&E'S REQUEST FOR LICENSE AMENDMENT NO. 97-11 (AUXILIARY SALTWATER SYSTEM PIPING BYPASS PROJECT, UNRESOLVED SAFETY QUESTION)

Plant Name: Diablo Canyon Power Plant (DCPP), Units 1 and 2
Licensee: Pacific Gas & Electric Company (PG&E)
Docket Nos. 50-275 and 50-323
Review Status: Completed
TAC Nos. M97914 and M97915

The Civil Engineering and Geosciences Branch has completed its review of PG&E's submittals of August 26, 1997 and October 14, 1997 for license amendment No. 97-11 related to the Auxiliary Saltwater (ASW) system piping bypass project. The attached safety evaluation report (SER) input is with respect to the civil engineering and geosciences aspects of the licensee's submittal. It deals with the unreviewed safety question pertaining to the soil liquefaction issue, and related topics such as slope stability in the vicinity of the ASW piping bypass.

In addition, this SER input covers the geotechnical parameters such as the seismically-induced settlements used by the Mechanical Engineering Branch in its evaluation of the ASW piping analysis.

Attachment: As stated

DISTRIBUTION:
File Center
ECGB RF
GLainas
JStrosnider
MHartzman

DOCUMENT NAME: g:\pichuman|dcaswpip.ser PA 11B1 TAC # M97914 & M97915
To receive a copy of this document, indicate in the box C=Copy w/o attachment/enclosure E=Copy with attachment/enclosure N = No copy

OFFICE	DE:ECGB	E	DE:ECGB		DE:ECGB	C	DE:ECGB	
NAME	RPichumani		ALowery		RRothman		GBagchi	
DATE	7/20/98		7/17/98		7/20/98		7/21/98	

OFFICIAL RECORD COPY

SAFETY EVALUATION REPORT INPUT FOR LICENSE AMENDMENT NO. 97-11 AUXILIARY SALTWATER SYSTEM PIPING BYPASS PROJECT AT DIABLO CANYON POWER PLANT
Civil Engineering and Geosciences Branch (ECGB/DE)
(TAC Nos: M97914 and M97915)

BACKGROUND

By letter dated January 27, 1997 (Ref.1), Pacific Gas and Electric Company (PG&E) informed the staff that it was implementing a design change that consisted of bypassing portions of the auxiliary saltwater (ASW) piping at the Diablo Canyon Power Plant (DCPP), Units 1 and 2. The existing ASW buried piping system was anchored to the circulating water conduits (CWCs) which are founded on, or embedded in, rock. The ASW bypass piping has been rerouted such that it is supported by the soil and is generally buried at a shallower depth than the existing piping. PG&E analyzed the design change in accordance with 10 CFR 50.59, and determined that it did not involve an unreviewed safety question (USQ). However, the staff's preliminary review of PG&E's geotechnical consultant's report (Ref. 2) indicated that there was a high probability of liquefaction of the medium dense sands on which a portion of the Unit 1 ASW piping is founded. During a teleconference with PG&E, the staff pointed out that founding safety related equipment or structures on liquefiable material is not part of the licensing basis for DCPP, and therefore it is a USQ. By letter dated August 26, 1997 (Ref. 3) PG&E submitted a license amendment request (LAR) 97-11 for NRC approval of an ASW system modification to install bypass piping.

After a preliminary review of LAR 97-11, the staff requested additional information (RAI) on the geotechnical aspects of the project. PG&E provided its response to the RAI by its October 14, 1997 letter (Ref. 4). A review of PG&E's submittal indicates that the only geotechnical aspect of this project is the issue of liquefaction of soils in an area along the Unit 1 ASW piping. Therefore, our SER input mainly deals with the subject of liquefaction and related topics such as slope stability and seismically-induced settlements in the vicinity of the ASW piping bypass.

EVALUATION

Geotechnical Parameters

The construction area of the ASW bypass buried pipeline consists of engineered backfill over bedrock with soil depths to bedrock ranging from five to 30 feet. The licensee had contracted with a consulting firm to conduct soil sampling and testing for the bypass route to obtain geotechnical inputs for the seismic and site response analysis of the ASW bypass piping and for the analysis of slope stability for the Unit 1 piping (which passes through the liquefiable soil zone). Based on these geotechnical investigations, the median (low-strain) shear wave velocity of the soil was taken as 800 feet per second, and uncertainty in the shear wave velocity was considered by using upper bound and lower bound velocities of 1,220 and 650 feet per second, respectively (Ref. 3). The modulus reduction and damping values for the site were also calculated in accordance with accepted geotechnical engineering practices. In addition, PG&E performed sensitivity studies for three cases of seismic wave incidence angles based upon the

ATTACHMENT

results of site specific studies performed during the Diablo Canyon Long Term Seismic Program (LTSP). PG&E's calculations and uncertainty analyses for the estimation of the geotechnical parameters for the project site are considered acceptable because the procedures for their estimation follow generally accepted engineering practices and previous procedures accepted by the staff for the Diablo Canyon LTSP.

Input Ground Motion and Soil/Structure Interaction (SSI) Analysis

The design basis seismic input for the Diablo Canyon Power Plant is based on the input ground motion applied to rock. However, the ASW bypass piping is not founded on the bedrock. It has been rerouted such that it is supported by the soil and is generally buried at a shallower depth than the original ASW piping. Therefore, PG&E performed a seismic site response analysis for different earthquakes, i.e., LTSP, Hosgri, and Double Design Earthquake (DDE) using the SHAKE program. An SSI analysis was also performed using the SASSI computer program to determine the displacements imposed on the buried piping system. In this analysis, PG&E considered the effects of variability in shear wave velocity, wave incidence angles, and soil modulus reduction. The staff considers the procedures used by PG&E in these analyses acceptable, as they are based on the current state of the art and conform to the relevant SRP section.

Liquefaction

There is a five-foot thick section of medium dense sand (located below the ground water table) at a depth of 25 feet (beneath the ASW piping bypass route) with low standard penetration test blow count data. PG&E's consultant evaluated the liquefaction potential of this sandy layer and found it susceptible to liquefaction during a major seismic event (Ref. 2). The 5-foot thick liquefiable layer is, however, surrounded by highly-dense materials which are not susceptible to liquefaction. Therefore, the important question is the areal extent of the liquefiable soil layer and the consequences of liquefaction of this layer. In response to a staff question on this subject, PG&E has stated that the engineered backfill placed previously in the Intake structure area (including portions of the sandy soils area) is dense to very dense, and that only localized zones (pockets) of liquefiable medium dense sand are present. However, PG&E conservatively assumed, for purposes of analysis, a larger area of liquefiable zone (approximately 10 to 20 feet wide and 120 feet long as shown on a detailed sketch submitted with Reference 4). The staff has reviewed the boring log data in this area and accepts PG&E's characterization of the liquefiable zone.

After defining the areal extent of the liquefiable zone, PG&E evaluated the possible settlement of the susceptible area using the LTSP earthquake peak ground acceleration (PGA) of 0.83g and assuming that the entire five feet of sand liquefied. The maximum vertical settlement calculated was 1.0 inch at the liquefiable depth to about 0.5 inch at the ground surface for the LTSP event. Differential settlement of the ASW Bypass piping could occur during an earthquake event because the pipeline crosses over the liquefiable zone of soils. PG&E has taken the maximum differential settlement to be the same as the maximum absolute ground surface settlement of 0.5 inch; and the staff agrees with this assumption. Horizontal spreading was not considered due to the highly dense nature of the surrounding soils which would contain the liquefied soils. The

staff considers the estimate of liquefaction-induced settlement acceptable, as it is based on reasonable assumptions related to the soil properties, and conforms to the recommendations of SRP Section 2.5.4 "Stability of Subsurface Materials and Foundations."

Slope Stability

Because the Unit 1 ASW bypass piping, in one section, descends at a 2:1 slope, PG&E performed a static slope stability analysis, and a pseudo-static stability analysis under a design basis seismic event. For the latter analysis, PG&E used the Hosgri earthquake which has a higher PGA than the DDE, i.e., 0.75g vs 0.40g, and a longer duration. PG&E also performed a pseudo-static slope stability evaluation using the LTSP earthquake (0.83g PGA). In the seismic stability analyses, PG&E utilized the residual shear strength of the medium dense sands assuming that they may liquefy under a seismic event. In response to a question about the basis for the value of the residual shear strength assumed in its analysis, PG&E has cited data based on post-earthquake field measurements (Ref. 4). The staff has verified the data given in Ref. 4 and found that the value of residual shear strength (700 pounds per square foot) used in the analysis is reasonable.

Based on its stability analyses, PG&E found that the static analysis yielded a factor of safety of 3.2 at the most critical slip plane, in excess of the design basis minimum of 1.5. PG&E further determined that the pseudo-static analyses yielded results sufficient to conclude that the slope displacements are insignificant for both Hosgri and LTSP earthquake ground motions. Because the licensee utilized the stability analysis procedures that generally conform to the SRP 2.5.5 "Stability of Slopes", and used the appropriate earthquake ground motions, the licensee's conclusions concerning the safety of the slope along the ASW Bypass route are acceptable to the staff.

CONCLUSION

Based on the review of PG&E's submittal (Refs.1 through 4) related to the proposed license amendment No. 97-11, the Civil Engineering and Geosciences Branch staff concludes that the geotechnical investigations performed by the licensee for the Diablo Canyon ASW System Piping Bypass Project are adequate and acceptable. The staff further concurs with PG&E's determination that the probable liquefaction of the 5-foot thick medium dense sand layer will induce a maximum vertical settlement of about 1.0 inch at the liquefiable depth and about 0.5 inch at the ground surface for the LTSP earthquake event. The staff also concurs with PG&E's estimation of the maximum differential settlement of the pipelines as 0.5 inch (which is equal to the maximum ground surface settlement) for the purpose of pipe stress analysis. Furthermore, the geotechnical input parameters (such as the earthquake ground motion and liquefaction-induced settlements of the buried pipes) used by PG&E in its pipe stress analysis as well as the slope stability analysis are reasonable and acceptable. In general, the licensee's analyses are considered acceptable to the staff as they conform to the requirements of the NRC Standard Review Plan Sections 2.5.4 and 2.5.5, the Diablo Canyon licensing bases, and generally accepted engineering practices.

References:

1. Letter dated January 27, 1997 from L. F. Womack, PG&E, to NRC. Subject: Diablo Canyon Units 1 and 2 Auxiliary Saltwater System Piping Bypass Project.

2. Harding Lawson Associates's Report dated August 23, 1996 to PG&E. Subject: Revised Report, Liquefaction Evaluation, Proposed ASW Bypass, Diablo Canyon Power Plant.

3. Letter dated August 26, 1997 from G.M. Rueger, PG&E, to NRC. Subject: Diablo Canyon Units 1 and 2 License Amendment Request 97-11 Auxiliary Saltwater System Piping Bypass Unreviewed Safety Question.

4. Letter dated October 14, 1997 from G.M. Rueger, PG&E, to NRC. Subject: Diablo Canyon Units 1 and 2 - Response to NRC Request for Additional Information on License Amendment Request 97-11, Auxiliary Saltwater System Piping Bypass Unreviewed Safety Question.