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RUEGER,G.M. Pacific Gas & Electric Co.
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SUBJECT: Forwards response to request for addl info on LAR 97-11 re auxiliary saltwater sys piping bypass unreviewed safety question.W/one oversize drawing.

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Drawings Located in Central Files

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Gregory M. Rueger
Senior Vice President and
General Manager
Nuclear Power Generation

October 14, 1997

PG&E Letter DCL-97-177

U.S. Nuclear Regulatory Commission
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Washington, D.C. 20555

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
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

Dear Commissioners and Staff:

On August 26, 1997, PG&E submitted License Amendment Request (LAR) 97-11 in PG&E Letter DCL-97-150. LAR 97-11 requested NRC review and approval, in accordance with 10 CFR 50.59 and 10 CFR 50.92, of a modification to the Diablo Canyon Power Plant Units 1 and 2 auxiliary saltwater (ASW) system to bypass approximately 800 feet of Unit 1 and 200 feet of Unit 2 Class 1 ASW piping, a portion of which is buried below sea level in the tidal zone outside the Intake Structure.

In a letter dated September 19, 1997, the NRC staff identified additional information required in order for them to complete their review. PG&E's response to the request for additional information is enclosed. This additional information does not affect the results of the safety evaluation performed for LAR 97-11.

Sincerely,

Gregory M. Rueger

A001

Drawing : Located in File Ctr.

Subscribed and sworn to before me
this 14th day of October 1997
County of San Francisco
State of California

D. Gena Jee

Notary Public

Attorneys for Pacific Gas and
Electric Company
Roger J. Peters
Richard F. Locke

Richard F. Locke

Richard F. Locke

D. GENA JEE
Commission #1067005
Notary Public — California
SAN FRANCISCO COUNTY
My Comm. Expires JUL 30, 1999

cc: Edgar Bailey, DHS
Steven D. Bloom
Ellis W. Merschoff
Kenneth E. Perkins
David L. Proulx
Diablo Distribution

Enclosure

Request for Additional Information
License Amendment Request 97-11
Docket Nos. 50-275 and 50-323

Question 1:

Justify your conclusion that the zone of potential liquefaction is limited in size, covering an area about 10 to 20 feet by 100 feet with a thickness of about 5 feet by providing both longitudinal sections and transverse (cross) sections of the soil profiles in the affected area of the ASW system bypass piping and indicating all pertinent soil parameters, such as the standard penetration test (SPT) blow counts, the fines content, etc., of the different soil layers, the elevations of the ASW pipe lines and bedrock. Also provide a legible and reasonably large size drawing showing the location of the AW system bypass piping and the soil borings.

PG&E Response to Question 1:

Background:

The entire Intake area and lower hillside were excavated to rock for construction of the Intake Structure (IS), intake circulating water conduits (CWCs), and original auxiliary saltwater (ASW) pipes. As-built excavation contour lines are shown on attached Sketch SK-C-4016686 (Attachment 1.1).

In 1972 and 1973, after construction of the IS and CWCs, the area was backfilled per PG&E Specification 8841, e.g. placing engineered backfill in level lifts not exceeding 8 inches in loose depth and compaction of layers to a relative compaction of 95%.

In 1980 an excavation was made to the top of the Unit 1 CWCs to repair electrical conduits and encase them in concrete. The approximate limits of the excavation are shown on the sketch. Specifications for compaction of backfill were similar to the original construction.

Boring Data in the May 8, 1996, Harding Lawson Associates (HLA) Report (Attachment 1.2):

The May 8, 1996, HLA report identified the presence of medium dense sand, of limited vertical extent near the groundwater table (GWT), in two borings, B-1 and B-4. These borings are located within the original engineered backfill placed in 1972 and 1973 following construction of the CWCs and original ASW pipes. Soil classifications and abbreviations referenced are defined in ASTM D2487.

9710200063

- Test boring B-1 shows a standard penetration test (SPT) blow-count of 18 at a depth of 25 feet in wet, medium dense, poorly graded sand (SP). This location is shown at elevation -1 foot, Mean Sea Level (MSL), on SK-C-4016686. This sand layer extends between depths of 23 feet and 26.5 feet (elevations +1 foot to -2.5 feet). The layer is overlain by clayey sand with gravel (SC) with higher blow counts.

- Test boring B-4 shows an equivalent pseudo SPT blow-count of 15 at a depth of 25 feet (elevation 0 feet MSL) in a medium dense, brown poorly graded sand layer with gravel (SP). This depth was below the GWT which was encountered at elevation +1 foot MSL at this location. This sand extends from a depth of 19 feet to a depth of 29 feet (elevations +6 feet to -4 feet). Near the top of this range, the sand is very dense and has a much higher blow count. This sand layer is underlain by dense poorly graded sandy gravel (GP), also having a much higher blow count. Elevations shown on the sketch have been adjusted from those shown on the HLA boring log based on a 1995 survey of nearby finished graded elevations.

Limits of Potential Liquefaction Zone:

The assumed limits of the medium dense sand which could be subject to potential liquefaction are shown in SK-C-4016686. The engineered backfill placed in the IS area, including portions of the subject SP sand layer, is dense to very dense. It is believed that only localized zones of medium dense sand are present. However, for purposes of analysis, it was conservatively assumed that the sand subject to potential liquefaction extended over the area approximately 10 to 20 feet by 120 feet in size as shown on the sketch:

- Horizontal limits (The northeastern limit of the zone near the crib wall is called "north"):

  - The northern limit, near the crib wall and thrustblock TB-6, is the adjacent rock surface of original excavation below the elevation 0 feet contour. See Sections A and E.

  - The eastern limit is the rock surface, below the elevation 0 feet contour, as shown on Sections A-D.

  - The southern limit is conservatively assumed to be near B-5 (1978) in the clayey engineered backfill placed in 1972 and 1973. No medium dense sand (SP) with low N values was found in B-4 (1978) or B-5 (1978). See Section E.

- The western limit is formed by the concrete encasement for electrical conduits located on top of a portion of the Unit 1 intake CWCs and overlying engineered backfill, both placed in 1980.

- Vertical limits:

  Vertical limits of the zone are assumed to be elevations 0 feet to -5 feet throughout the area of zone described above. The upper limit is at MSL, elevation 0 feet. Based on the vertical thickness of SP sand in B-4, the zone is assumed to be 5 feet thick.

Review of data from FSAR Figures 2.5-8 and 2.5-10, several soil investigations performed by HLA, and placement and compaction records for engineered backfill has provided no other indication of medium dense sand (SP) with low N values near the ASW bypass pipes.

Sketch and Soil Information:

Sketch SK-C-4016686 shows the ASW bypass pipes for both units and relative locations of nearby borings, bedrock, and structures. Section E shows a profile along the length of the zone of potential liquefaction.

Data for in-situ visual classification and testing, including SPT blow counts, fines content, etc. for Borings B-1 and B-4 are included in the attached excerpts from the May 8, 1996 HLA report. Boring logs for B-4 (1978) and B-5 (1978), are included in attached excerpts from the April 12, 1978 HLA report (Attachment 1.3).

<u>Attachments:</u>

1.1 Sketch SK-C-4016686, Revision 0, "Potentially Liquefiable Sand Layer Limits Near ASW Bypass Piping."

1.2 Excerpts from HLA report "Geotechnical Field and Laboratory Investigation, ASW System Bypass", Project No. 10183-055, dated May 8, 1996.

1.3 Excerpts from HLA report, "Geotechnical Studies - Intake Structure, Water Storage Tanks, Diesel Fuel Oil Storage Tanks," dated April 12, 1978 - Information for B-4 (1978) and B-5 (1978).

Question 2

Provide the detailed calculations along with necessary justifications for any assumptions made in support of your assessment that the upper bound settlements would vary from about 1 inch in the liquefiable zone to about 0.5 inch near the ground surface for a Hosgri or LTSP size earthquake.

PG&E Response to Question 2

See Attachment 2.1 for HLA detailed calculation which contains their liquefaction analysis for the ASW bypass, including assumptions and seismically-induced settlements. This calculation documents that 1 inch is the upper bound for settlement of the medium dense cohesionless layer if it does entirely liquefy. This is the settlement that could occur at the top of the layer and the settlement at the ground surface would be less due to soil arching. Soil arching is defined as the transfer of pressure from a yielding mass of soil onto adjacent areas of nonyielding soil or rock. This phenomenon is well documented in the literature based on both laboratory tests and field observations (Attachment 2.2). At the ASW bypass piping site, the zone of medium dense sand that may densify during an earthquake is bounded on the sides either by bedrock, the Unit 1 CWC, and very dense fill that because of its stiffness, will be relatively nonyielding with respect to the medium dense sand. The zone of medium dense sand is also overlain by stiff to hard compacted clay fill that will further help bridge over the yielding area and thereby reduce settlements near the ground surface. Based on this reasoning, HLA used judgment to conclude that the upper bound for settlement near the ground surface will be ½ inch. We believe this estimate represents a conservative upper bound for the seismically induced settlement near the ground surface and that the actual settlement will be less.

Attachments

2.1 HLA Calculation No. 10183-96-02, Rev. 0, dated July 18, 1996, ASW Bypass Liquefaction Analysis

2.2 Terzaghi, Karl, Theoretical Soil Mechanics, John Wiley & Sons, Inc., New York, 1943, pages 66 through 76.

Question 3

Describe and justify the accuracy of the procedure used to convert the blow counts measured by a larger sampler to equivalent SPT blow count (N) values.

PG&E Response to Question 3

A blow count correction factor of 0.7 was used in Attachment 2.1 to convert the Modified California Sampler [i.e, Outside Diameter (OD) of 3 inches and Inside Diameter (ID) of 2.43 inches] blow counts from Boring 4 at 25 feet into equivalent SPT [i.e., OD of 2 inches and ID of 1.375 inches] N-values. The correction factor is based on the concept that the larger the cross-sectional area of the sampler, the more difficult it is to drive into the ground. Based on conventional geotechnical practices, a linear relationship is typically assumed between the penetration resistance and the cross-sectional area of the sampler.

This area correction factor (ACF) is calculated as follows:

$$ACF = \frac{Area_{SPT}}{Area_{Mod.Calif.}}$$

$$ACF = \frac{\frac{\pi}{4}\left[(2\ in.)^2 - (1.375\ in.)^2\right]}{\frac{\pi}{4}\left[(3\ in.)^2 - (2.43\ in.)^2\right]} = 0.68, \quad use\ ACF = 0.7$$

References

- HLA Calculation No. 10183-96-02, Rev. 0, dated July 18, 1996, ASW Bypass Liquefaction Analysis (See Attachment 2.1)

Question 4

Provide a copy of the report by your consultant, Harding Lawson Associates (HLA), titled "Geotechnical Slope Stability Evaluation, ASW System Bypass Unit 1, Diablo Canyon Power Plant," dated July 3, 1996. The staff is interested in the basis for the residual shear strength of the liquefied soil used in the seismic slope stability analysis. Also provide a detailed summary of Bechtel's Geotechnical Engineering Group's report that verified HLA's slope stability analysis.

PG&E Response to Question 4

See Attachment 4.1 for a copy of the requested HLA report. This HLA report was verified by Bechtel's Geotechnical Group. HLA had used a commercially available computer program, known as UTEXAS3 with the Spencer Method Option, for its slope stability analysis. Bechtel was contracted to: (1) QA validate their computer program, known as SLOPE/W, for the Spencer Method Option, and (2) verify HLA's results by running their validated computer program with HLA's input data. Bechtel's calculated minimum factors of safety for the critical cases were in good agreement with the HLA results.

The residual shear strength of the liquefied soil used in HLA's slope stability analysis was determined using Figure 11 from Attachment 4.2. Since a critical slip surface could pass through several points in the medium dense sand layer, HLA used the average of the two lowest blow counts for this layer when using Figure 11. In addition, HLA extrapolated the curves in Figure 11 to reach a blow count of 17 and then used the curve to select the residual shear stress of 700 psf. It should be noted that while HLA assumed that the two lowest blow counts represent the entire sand layer, a third location within this sand deposit had a blow count of 35 for 4 inches of penetration. This data point indicates that this layer is not entirely medium dense, but more likely, contains areas that are dense to very dense. Hence, the selected residual shear strength used by HLA represents a conservative estimated strength for this sand layer.

Attachments

4.1 HLA report, dated July 3, 1996, entitled "Geotechnical Slope Stability Evaluation - ASW System Bypass, Unit 1 - Diablo Canyon Power Plant - San Luis Obispo County, California."

4.2 Seed, Raymond B. and Leslie F. Harder, Jr., "SPT-based Analysis of Cyclic Pore Pressure Generation and Undrained Residual Strength," from Volume 2, H. Bolton Seed Memorial Symposium, Proceedings, May 1990, Editor J. Michael Duncan, BiTech Publishers Ltd., Vancouver, B.C., Canada.

Attachment 1.1

Sketch SK-C-4016686, Revision 0,
"Potenitally Liquefiable Sand Layer Limits
Near ASW Bypass Piping"

(Note: The signed original drawing is available on site)

Attachment 1.2

Excerpts from Harding Lawson Associates report
"Geotechnical Field and Laboratory Investigation, ASW System Bypass,"
Project No. 10183-055, dated May 8, 1996

Geotechnical Field and Laboratory Investigation
ASW System Bypass, Units 1 & 2
Diablo Canyon Power Plant
San Luis Obispo County, California

Prepared for

Pacific Gas & Electric Company
245 Market Street, Room 823B
San Francisco, California 94107

HLA Project No. 10183-055

Elizabeth K. Oman
Civil Engineer

W. Andrew Herlache
Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
WARD ANDREW HERLACHE
No. GE 002149
Exp. 3/31/99
GEOTECHNICAL
STATE OF CALIFORNIA

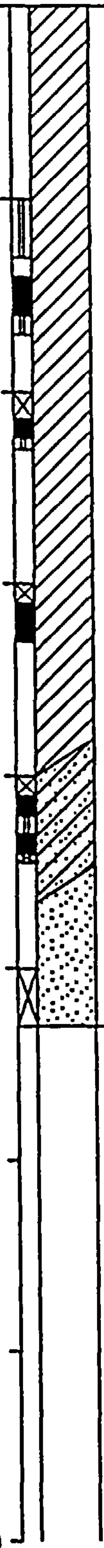
May 8, 1996

Harding Lawson Associates
Engineering and Environmental Services
150 Fourth Street, Suite 527
San Francisco, CA 94103 (415) 543-8422

Equipment 8" Diameter HSA**

Elevation 24*** ft Date 12/20/95

Laboratory Tests	Moisture Content (%)	Dry Density (pcf)	Blows/foot	Depth (ft)	Sample / Description
				0	DARK BROWN SANDY LEAN CLAY (CL) stiff, moist, fill
Bulk Sample 0-20': PI 19, LL 43, 66.0% -200 Maximum Dry Density 112.2 pcf Optimum Moisture Content 12.8%			10*	5	
			9*		
TxUU (1500) 1225 62.2% -200	28.0	92	22*	10	
	22.2	95	35	15	
16.7% -200	7.1	120	30*	20	CLAYEY SAND WITH GRAVEL (SC) dense, moist, coarse-grained sand, with angular gravel up to 1", fill
	6.9	121	35/3"*		LIGHT BROWN POORLY GRADED SAND (SP) medium dense, wet
			18	25	
					Boring was terminated at 26.5 feet. Hole was backfilled with cuttings. No free groundwater encountered.
				30	
				35	
				40	



* S&H sampler blow counts, indicated with an asterisk, were converted to pseudo-SPT N-values by multiplying field values by 0.7. Unmarked blow counts are SPT N-values.

** HSA = Hollow Stem Auger

*** Mean Sea Level

Harding Lawson Associates
Engineering and
Environmental Services

Log of Boring B-1 (Sheet 1 of 1)

Diablo Canyon ASW Bypass
San Luis Obispo County, California

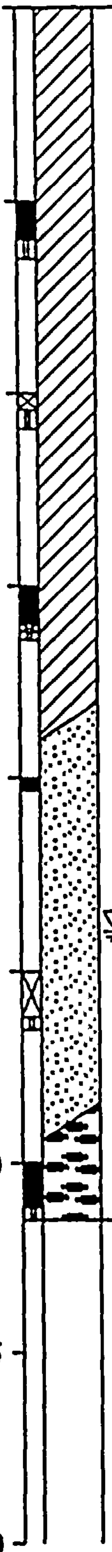
PLATE **2**

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED DATE
EO	10183-055	ZLO	20180G27		

Equipment 8" Diameter HSA**

Elevation 24*** ft   Date 12/21/95

Laboratory Tests	Moisture Content (%)	Dry Density (pcf)	Blows/foot	Depth (ft)	Description
				0	BROWN LEAN CLAY WITH SAND AND GRAVEL (CL) moist, with fine to large gravel, fill
	19.2	102	34*	5	stiff at 5 feet
			35/4"*	10	
			39*	15	
			35/4"*	20	BROWN POORLY GRADED SAND WITH GRAVEL (SP) very dense, moist, medium- to coarse-grained with gravel up to 3/4", fill
					water level measured during drilling
			15*	25	becoming medium dense at 25 feet
			43*	30	BROWN POORLY GRADED SANDY GRAVEL (GP) dense, saturated, with high amount of large gravel up to 2.5", fill
					Boring terminated at 31.5 feet Hole backfilled with cuttings.
				35	
				40	



Harding Lawson Associates
Engineering and Environmental Services

Log of Boring B-4 (Sheet 1 of 1)
Diablo Canyon ASW Bypass
San Luis Obispo County, California

PLATE **5**

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED DATE
EO	10183-055		20180G27		

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2487-85)

MAJOR DIVISIONS				GROUP NAMES
COARSE-GRAINED SOILS More than 50% retained on the No. 200 sieve	GRAVELS More than 50% of coarse fraction retained on No. 4 sieve	Clean gravels less than 5% fines	GW	WELL-GRADED GRAVEL, WELL-GRADED GRAVEL WITH SAND
			GP	POORLY-GRADED GRAVEL, POORLY-GRADED GRAVEL WITH SAND
		Gravels with more than 12% fines	GM	SILTY GRAVEL, SILTY GRAVEL WITH SAND
			GC	CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND
	SANDS 50% or more of coarse fraction passes No. 4 sieve	Clean Sand less than 5% fines	SW	WELL-GRADED SAND, WELL-GRADED SAND WITH GRAVEL
			SP	POORLY-GRADED SAND, POORLY-GRADED SAND WITH GRAVEL
		Sands with more than 12% fines	SM	SILTY SAND, SILTY SAND WITH GRAVEL
			SC	CLAYEY SAND, CLAYEY SAND WITH GRAVEL
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid limit less than 50%		ML	SILT, SILT WITH SAND OR GRAVEL, SANDY OR GRAVELLY SILT
			CL	LEAN CLAY, LEAN CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY LEAN CLAY
			OL	ORGANIC SILT OR CLAY, ORGANIC SILT OR CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY ORGANIC SILT OR CLAY
	SILTS AND CLAYS Liquid Limit 50% or more		MH	ELASTIC SILT, ELASTIC SILT WITH SAND OR GRAVEL, SANDY OR GRAVELLY ELASTIC SILT
			CH	FAT CLAY, FAT CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY FAT CLAY
			OH	ORGANIC SILT OR CLAY, ORGANIC SILT OR CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY ORGANIC SILT OR CLAY
HIGHLY ORGANIC SOILS			Pt	PEAT

For definition of dual and borderline symbols, see ASTM D2487-85.

KEY TO TEST DATA

Perm	-	Permeability
Consol	-	Consolidation
LL	-	Liquid Limit
PI	-	Plasticity Index (%)
Gs	-	Specific Gravity
MA	-	Particle Size Analysis
-200	-	Percent Passing No. 200 Sieve
■	-	"Undisturbed" Sample
⊠	-	Bulk or Classification Sample
◫	-	Lost Sample

	Shear Strength (psf)	Confining Pressure	
TxUU	3200	(2600)	- Unconsolidated-Undrained Triaxial Shear
TxCU	3200	(2600)	- Consolidated-Undrained Triaxial Shear
TxCD	3200	(2600)	- Consolidated-Drained Triaxial Shear
SSCU	3200	(2600)	- Consolidated-Undrained Simple Shear
SSCD	3200	(2600)	- Consolidated-Drained Simple Shear
DSCD	2700	(2000)	- Consolidated-Drained Direct Shear
UC	470		- Unconfined Compression
LVS	700		- Laboratory Vane Shear
FV	500		- Field Vane Shear
TV	800		- Torvane Shear
PP	400		- Pocket Penetrometer (actual reading divided by 2)

Harding Lawson Associates
Engineering and
Environmental Services

Soil Classification Chart
and Key to Test Data
Diablo Canyon Power Plant
San Luis Obispo County, California

PLATE **6**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
JMV	10183-055	[signature]	2/96	

Attachment 1.3

Excerpts from Harding-Lawson Associates report, "Geotechnical Studies - Intake Structure, Water Storage Tanks, Diesel Fuel Oil Storage Tanks," dated April 12, 1978 - Information for B-4 (1978) and B-5 (1978)

GEOTECHNICAL STUDIES
INTAKE STRUCTURE
WATER STORAGE TANKS
DIESEL FUEL OIL STORAGE TANKS
DIABLO CANYON NUCLEAR POWER PLANT
SAN LUIS OBISPO COUNTY, CALIFORNIA

HLA Job No. 569,031.04

A Report Prepared for

Pacific Gas & Electric Company
77 Beale Street
San Francisco, California 94106

by

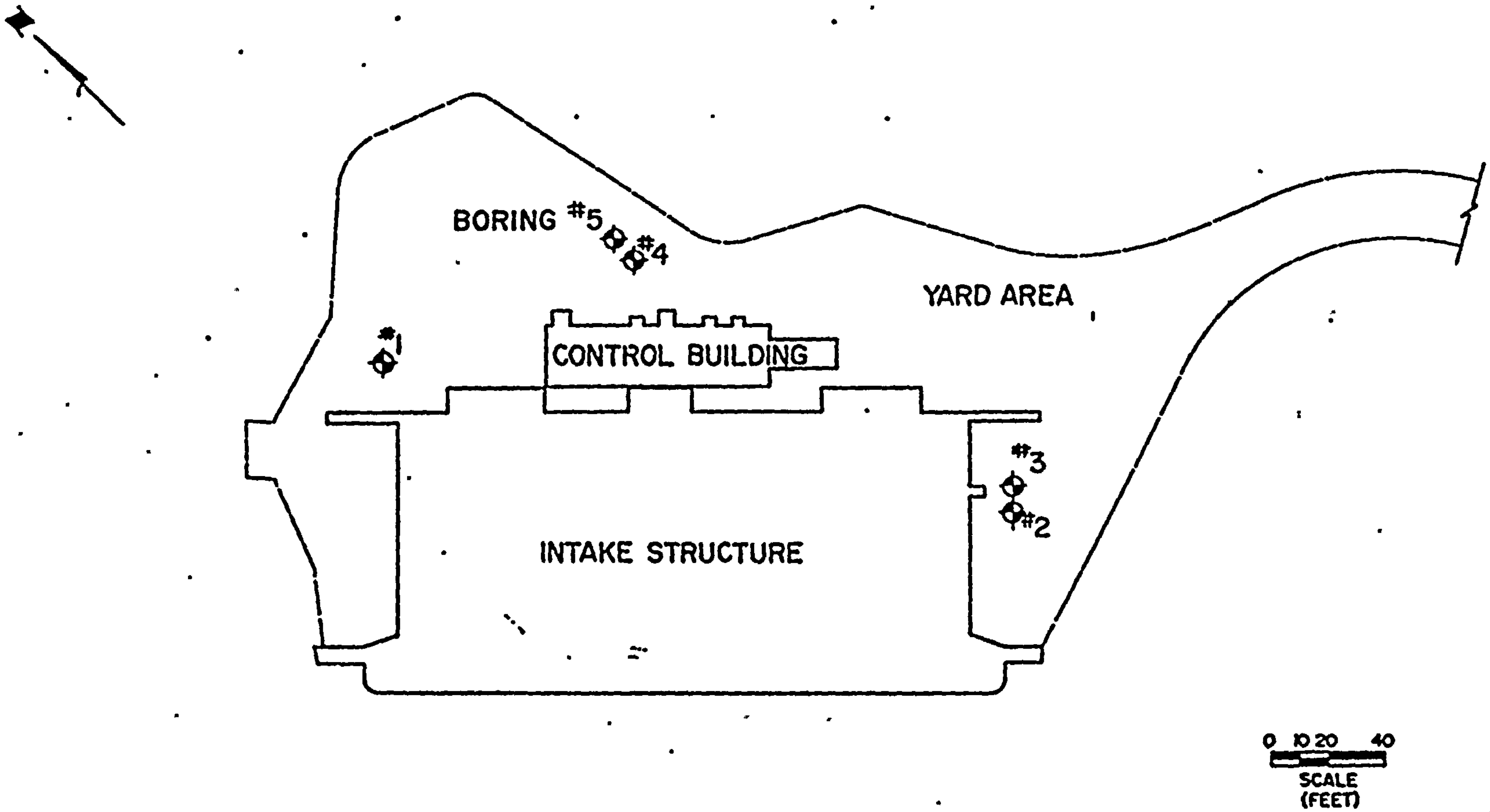
Albert L. Buchignani
Civil Engineer 13744

Takekazu Udaka, Ph.D

Robert T. Lawson
Civil Engineer 9715

Harding-Lawson Associates
20 Hawthorne Street
San Francisco, California 97105
(415) 543-8422

April 12, 1978



RENCE: PG & E Drawing No. 438064
Intake :- Fill, Paving & Fencing
Diablo Canyon. Dated 6-3-70

SITE PLAN

INTAKE STRUCTURE
DIABLO CANYON

San Luis Obispo County California

Consulting Engineers and Geologists

PLATE
1

SITE AND SUBSURFACE CONDITIONS

The ground surface is paved and level. The paving is underlain by backfill behind the north, east and south sides of the Intake Structure.

The borings were drilled in the backfill behind or beside the structure at the locations shown on Plate 1. The fill ranges from 25 feet deep in Boring 4 to 35 feet in Borings 2 and 3. Boring 1 penetrated stiff clay fill to a depth of 15 feet, underlain by gravel and sand to 26 feet. The fill in Borings 2 and 3 is mainly sand and gravel to a depth of 23 feet, underlain by about 10 feet of stiff clay overlying bedrock. In Borings 4 and 5, 25 feet of clay backfill is underlain by bedrock (Boring 4) or a shallow thickness of sand and gravel and then concrete (Boring 5). The groundwater table was observed in Borings 1, 2 and 3 at a depth of about 20 feet below the ground surface (approximately Mean Sea Level). The groundwater levels in Borings 4 and 5 did not stabilize before the borings were backfilled.

The bedrock in Borings 2, 3 and 4 is moderately strong black shale. Because of the type of drill rig used, rock coring was not done; therefore, classification is based on drill cuttings and previous inspections prior to placement of the base slab in 1972. Our 1972 inspection records* of the

*Harding-Lawson Associates - Site Inspection Memorandum dated March 12, 1972

APPENDIX B

FIELD EXPLORATION AND LABORATORY TESTING

foundation excavation note shale or siltstone bedrock over the entire foundation area. Volcanic Tuff intrusions were found in cut slopes adjacent to the excavation.

LABORATORY TESTS

Samples taken from the test borings were reexamined in the laboratory to aid in planning of the testing program. Both static and dynamic tests were performed on representative samples. Moisture content/dry density tests, liquid and plastic limit tests, sieve analyses, and minus #200 sieve tests were performed to aid in classifying and identifying the subsurface materials. The results of these tests are shown on the boring logs. The results of sieve analyses tests are shown on Plate 56. Unconsolidated-undrained triaxial tests were used to determine the static strength of the soils. The results of these tests are shown on the borings logs. A Key to the presentation of the strength data is presented on Plate 55.

Both cyclic triaxial and resonant column tests were used to evaluate the dynamic properties of the soils. Detailed test reports for these tests are presented on Plates 57 through 59.

LOG OF BORING 4

Equipment: 5" Diameter Continuous Auger
Elevation: 17.5'   Date: 2-7-78

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Description
			0	ASPHALT PAVEMENT OVER BASE ROCK
	25.8	97		BROWN GRAVELLY CLAY (CL) stiff, moist
			5	
			10	
27% Passing #200 Sieve	16.6	96	15	sandy from 14' to 17'
			20	large rock fragment - no recovery
			25	BLACK SHALE moderately strong to strong
				ground water level not observed
			30	
			35	
			40	

FILL (0' to approx. 25.5')

HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 569,031.04   Appr: A.L.   Date 2-21-78

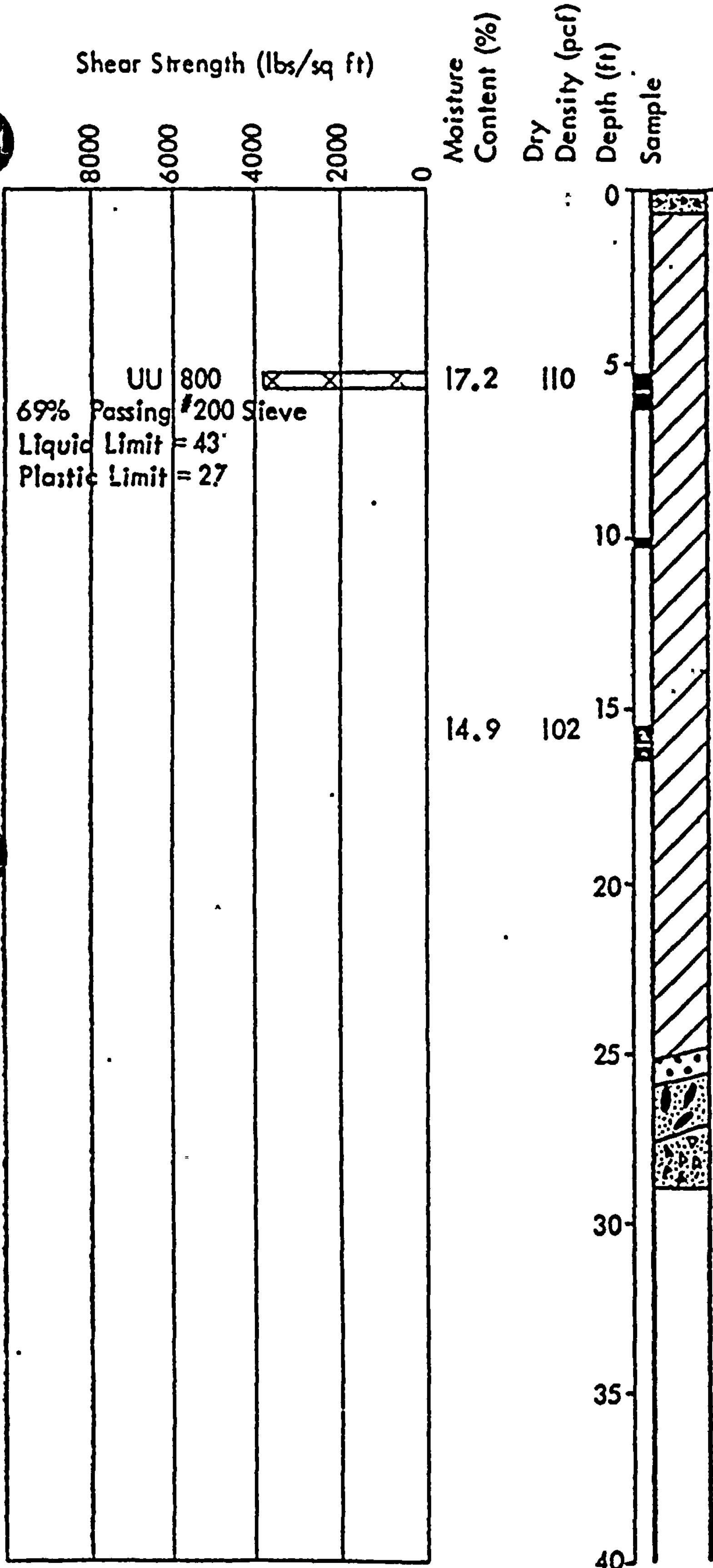
LOG OF BORING 4
DIABLO CANYON
INTAKE STRUCTURE
San Luis Obispo, California

PLATE 40

LOG OF BORING 5

Equipment 5" Diameter Continuous Auger

Elevation 17.5' Date 2-7-78



ASPHALT PAVEMENT OVER BASE ROCK
with large rock fragments

DARK BROWN GRAVELLY CLAY (CL)
stiff, moist

GRAY COARSE SAND (SP)
medium dense, saturated

GRAY GRAVEL (GP)
very dense, saturated
slow drilling

GRAY CONCRETE

ground water level not observed

FILL

HARDING-LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No 569,031.04 Appr: E.L.B. Date 2-21-78

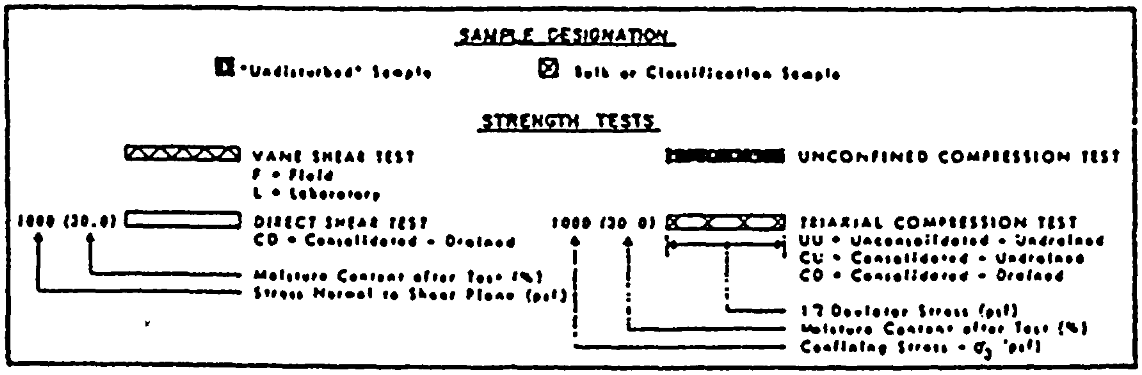
LOG OF BORING 5
DIABLO CANYON
INTAKE STRUCTURE
San Luis Obispo California

PLATE
41

F3

MAJOR DIVISIONS					TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN HALF IS LARGER THAN #200 SIEVE)	GRAVELS (MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP		POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM		SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC		CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS (MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE)	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS
			SP		POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM		SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC		CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN HALF IS SMALLER THAN #200 SIEVE)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)		ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL		ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50)		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM



KEY TO TEST DATA

HARDING-LAWSON ASSOCIATES Consulting Engineers and Geologists	SOIL CLASSIFICATION CHART AND KEY TO TEST DATA DIABLO CANYON San Luis Obispo California	PLATE 55
Job No 569,031.04 Appr: ALL Date 2-24-78		

<u>Attachment 2.1</u>

HLA Calculation No. 10183-96-02, Rev. 0, dated 7/18/96,
ASW Bypass Liquefaction Analysis