HUMBOLDT BAY POWER PLANT DATA REPORT B

BORING LOGS

HUMBOLDT BAY POWER PLANT ISFSI

PREPARED BY:	[signature]	DATE:	4/26/2002
	Karthik Narayanan		Geomatrix
	Printed Name		Organization
VERIFIED BY:	Robert K White	DATE:	5/2/02
	Robert K. White		Geosciences
	Printed Name		Organization
APPROVED BY:	[signature]	DATE:	5/10/02
	Lloyd Cluff		Geosciences
	Printed Name		Organization

REGISTERED PROFESSIONAL ENGINEER
ROBERT K. WHITE
37401
Exp. 6/30/04
CIVIL
STATE OF CALIFORNIA

DATA REPORT B
BORINGS LOGS
HUMBOLDT BAY POWER PLANT ISFSI SITE

TABLE OF CONTENTS

FIGURES

ATTACHMENTS

\\oak1\deptdata\Project\5000s\5117.009\Data reports\Report_B\Data Report B.doc

HUMBOLDT BAY ISFSI DATA REPORT B

BORINGS IN ISFSI SITE AREA

HUMBOLDT BAY ISFSI

1.0 INTRODUCTION

Subsurface conditions at two of the potential ISFSI sites S-2 and S-4 (Figure B-1) were characterized by drilling five exploratory borings in February and December, 1999. Borings were drilled and sampled to depths ranging from about 62 to 420 feet. Downhole shear wave velocity measurements were made in two of the borings. Upon completion, boring locations were surveyed (PG&E, 1999, PG&E, 2000). Boring locations are shown on Figure B-1.

Soil samples were collected from the borings to aid in characterizing subsurface conditions and for subsequent geotechnical laboratory testing. Soil samples were collected using the following sampler types:

- a modified California drive sampler (2.0-inch inside diameter [ID], 2.5-inch outside diameter [OD]);
- a large modified California drive sampler (2.5-inch ID, 3.0-inch OD);
- a 94-millimeter (mm) core barrel with a modified California sampler (2.0-inch ID, 2.5-inch OD);
- a Standard Penetration Test (SPT) sampler (1.375-inch ID, 2.0-inch OD);
- a 3-inch-diameter thin-walled Shelby tube advanced by pushing or Pitcher drilling.

The modified California samplers were lined with thin, segmented brass tubes. Sampler types are indicated on the boring logs and on the boring log explanation sheet.

When samplers were withdrawn from the borings, the soil samples were removed and sealed to preserve their natural water content. Preliminary visual soil classifications were made in the field in general accordance with ASTM Method D 2488 (ASTM, 1999) and verified by further inspection in the laboratory and by test results. Final boring logs were developed from the laboratory test results and from conditions recorded on the field logs. A boring log explanation sheet is presented on Figure B-2, and final boring logs are shown on Figures B-3 through B-7 of this data report.

2.0 METHODOLOGY

Five borings were drilled in February and December, 1999. Prior to commencing the field exploration program, a work plan was developed by Geomatrix Consultants (Geomatrix) and approved by PG&E. PG&E reviewed the work plan and subsequent revisions were made to the plan. In addition, as required by law, Underground Service Alert (USA) was contacted to help locate utilities at the site prior to performing the field exploration program. Personnel at the Humboldt Bay Power Plant (HBPP) also helped to clear existing utility locations in the vicinity of the planned exploration locations.

During drilling operations, Mr. John Wesling, Senior Geologist with Geomatrix Consultants, maintained a record of field activities, classified the soils encountered, and prepared a continuous log of each boring. Drilling was performed by All Terrain Exploration Drilling Company of Pleasant Grove, California (All Terrain) using mud rotary drilling techniques.

2.1 DRILLING

Boring 99-1 (Figure B-3) was drilled on February 10 and 11, 1999 and was advanced to a total depth of 95 feet using a 4 7/8-inch diameter tricone bit. Boring 99-2 (Figure B-4) was drilled from February 12 to 19, 1999, to a total depth of 420 feet, using a 4 7/8-inch diameter tricone bit in the upper 200 feet, and a 94-mm core barrel with a 5 1/2-inch diameter bit used in the lower 220 feet. The drilling was performed by All Terrain using a truck-mounted Failing 1500 drill rig.

Boring 99-3 (Figure B-5) was drilled on December 6 and 7, 1999 and was advanced to a total depth of 77.3 feet. Boring 99-4 (Figure B-6) was drilled on December 7 and 8, 1999 and was advanced to a total depth of 63 feet. Boring 99-5 (Figure B-7) was drilled on December 8 and 9, 1999 and was advanced to a total depth of 61.9 feet. All borings were advanced using mud rotary drilling and a 4 7/8-inch diameter tricone bit. The drilling was performed by All Terrain using a track-mounted CME 850 drill rig.

2.2 SAMPLING

Soil samples generally were collected continuously in the upper 20 feet, at 5-foot intervals between 20 and 80 feet, and at 20-foot intervals below 80 feet. Additional samples were collected between the specified 5- and 20-foot intervals if a change in soil type or consistency was detected during drilling, when the geologist needed additional samples to assess variability in a particular soil unit, or at the geologist's discretion to ensure that enough samples from a particular soil unit were obtained for testing. Sampling was performed to a depth of 200 feet using modified California drive samplers, a Standard Penetration Test sampler, a pushed Shelby tube, or a Pitcher sampler. Below a depth of 200 feet, in Boring 99-2, samples were recovered using the 94-millimeter coring system equipped with a modified California sampler lined with brass tubes as the inner-sampling barrel.

In borings 99-1 and 99-2, modified California and SPT samplers were driven into the soil with a 140-pound safety hammer falling 30 inches. The hammer was raised using a rope and cathead arrangement. In borings 99-3, 4, and 5, modified California and SPT samplers were driven with an automatic-trip hammer. Samplers were driven 18 inches or to refusal (defined as either 50 blows in 6-inches or until no advancement of the sampler was observed for 10 successive blows), whichever occurred first. In some instances where refusal occurred, the sampler was advanced using more than 50 blows to obtain sufficient sample for identification and description purposes. The blowcounts for each 6-inch interval of the drive, or portion thereof, are presented at the corresponding sample depths on the boring logs.

Shelby and Pitcher tubes and brass liners from modified California samplers were sealed by placing plastic caps on each end and then securing each cap with duct tape. Caps for samples from 99-3, 4, and 5 were sealed with hot wax. SPT samples were placed in ziplock plastic bags. Soil samples were stored in a secure, locked area and logged onto a sample list in order to track the location and presence of each sample. The samples were transferred from the site to the Geomatrix warehouse in San Leandro, California for further inspection, and then to Cooper Testing Laboratory in Mountain View, California for laboratory testing.

2.3 ENERGY MEASUREMENTS

During the collection of drive samples from Boring 99-1, Goble Rausche Likins and Associates, Inc. (GRL) recorded measurements of hammer energy in drive samples from the ground surface to a depth of 40 feet using a pile driver analyzer. A detailed report of GRL's findings appears in Appendix 1 of this data report.

2.4 MISCELLANEOUS

Soil cuttings and drilling fluid generated during drilling were collected on a trailer. They were then disposed of as directed by PG&E. Material from Boring 99-1 was disposed of at the plant's fill site on the north side of the plant. Cuttings from Borings 99-2, 99-3, 99-4, and 99-5 were spread on the ground surface near the borings. After completion of drilling, sampling and logging boreholes 99-1 and 99-2, downhole geophysical logging (shear and compression wave velocity measurement) was performed by GEOVision. The borehole walls were stable and did not require casing to facilitate suspension logging. The results of the downhole geophysical logging are contained in Data Report C, "Downhole Geophysics in ISFSI Site Area." Borings 99-1 and 99-2 were backfilled to the surface with cement grout upon completion of the downhole geophysical logging. Borings 99-3, 99-4, and 99-5 were backfilled to the surface with cement grout immediately upon completion of drilling, sampling, and logging activities.

3.0 RESULTS

The subsurface conditions at site S-2, as observed from boring 99-1, generally consists of 15 feet of medium dense to dense silty sand (SM) and very stiff clay with sand (CL) containing little to no gravel, overlying dense to very dense gravelly, well to poorly graded sand (SW, SP) to the depth explored (95 feet).

Subsurface conditions at site S-4, as observed from borings 99-2, 99-3, 99-4, and 99-5 consist of medium dense clayey sand and stiff sandy clay in the upper 8 to 12 feet. Below the upper layer, very stiff silts and clays were encountered to depths of about 20 feet. This layer is underlain by 3 to 6 feet of hard silty clay. Underlying the cohesive soils in the upper 24 to 26 feet are very dense sand and silty sand extending to depths of 50 to 53 feet. In boring 99-5, the sand grades to very stiff to hard sandy silt and silt. A relatively thin layer (less than 10 feet thick) of hard silt and silty clay with a thin stratum of very stiff peat was encountered at a depth of approximately 55 feet. The borings were terminated in the dense to very dense sand and gravel below this layer – at depths ranging from 62 to 420 feet.

Blowcount energy measurements made by GRL for borings 99-1 and 99-2 indicated a hammer efficiency of approximately 50%. For these two borings, drive samplers were advanced using a rope and cathead arrangement. Such energy measurements were not made in borings 99-3, 99-4, and 99-5, in which drive samplers were advanced with an automatic trip hammer. Energy measurement data and results are presented in Attachment 1 of this data report.

4.0 REFERENCES

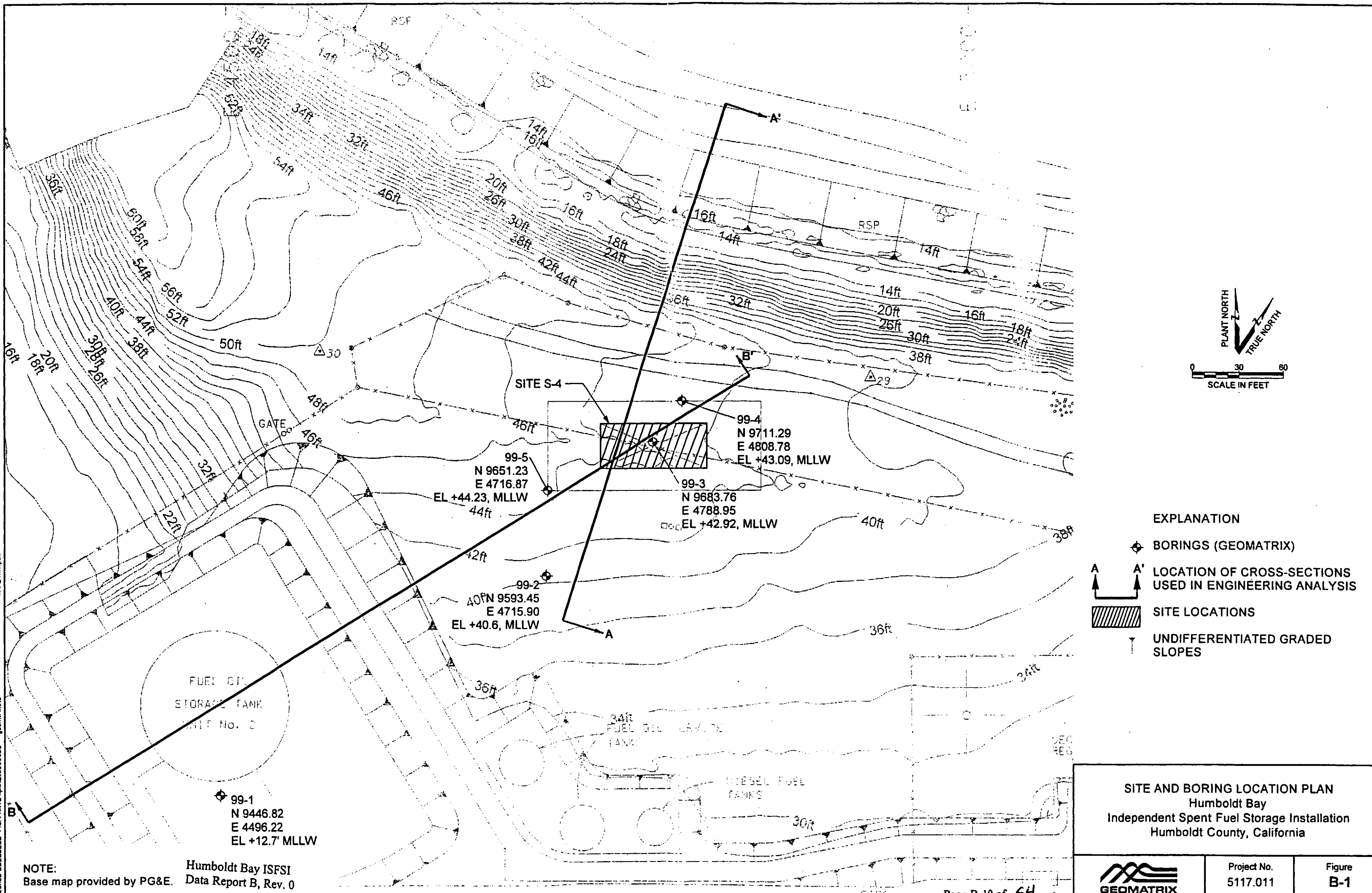
American Society for Testing and Materials (ASTM), 1999, Annual Book of ASTM Standards, Section 4, Volume 04.08.

PG&E, 2000, Report of Survey for Geotechnical Drilling Locations for the HBPP ISFSI Site, January 4.

PG&E, 1999, Report of Survey for Geotechnical Drilling Locations for the HBPP ISFSI Site, July 13.

BLANK PAGE

BLANK PAGE



SITE AND BORING LOCATION PLAN
Humboldt Bay
Independent Spent Fuel Storage Installation
Humboldt County, California

GEOMATRIX

Project No.	Figure
5117.011	B-1

NOTE:
Base map provided by PG&E.

Humboldt Bay ISFSI
Data Report B, Rev. 0

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Boring Log Explanation

DEPTH (feet)	Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
				Standard penetration split spoon drive sampler, 2-inch outside diameter, 1 3/8-inch inside diameter (without liners)			
				Modified California drive sampler, 2 1/2-inch outside diameter, 2.0-inch inside diameter (with liners)			
				Modified California drive sampler, 3-inch outside diameter, 2 1/2-inch inside diameter (with liners)			
		C		94 millimeter coring system			
		S		Shelby tube sampler			
		P		Pitcher barrel sampler, 3-inch inside diameter			
			21 27 35	Blow count for every 6-inches of sample, or as noted			
				Distinct contact			
				Gradual or uncertain contact			
				Unconfined Compressive Strength in ksf			UC=1.30
				Percentage of fine passing No. 200 sieve			<200=44%
				Grain size distribution test			Sieve
				LL=Liquid limit; PI=Plasticity index			LL=27, PI=4
				Unconsolidated-Undrained Triaxial Test, shear strength in ksf (confining pressure in ksf)			UU=5.30 (3.10)
				Isotropically Consolidated-Undrained Triaxial Compression			ICU-TC
				Consolidation Test			Consol

NOTES:

1. The stratification lines shown on the boring logs represent the approximate boundaries between material types. The actual transitions between materials may be gradual.
2. These logs of the test borings and related information depict subsurface conditions only at the specific locations and at the particular time the boring was made.
3. Soil conditions at other locations may differ from conditions occurring at these locations. Also, the passage of time may result in a change in the soil and groundwater conditions at these locations.
4. Soil colors from Munsell Soil Color Charts

GT-2 (6/98)

EXP-698 5117EXPL.GPJ GES91999.GDT 3/27/02

PROJECT: HUMBOLDT BAY Independent Spent Fuel Storage Installation Humboldt County, California	# Log of Boring No. 99-1	
BORING LOCATION: N 9446.82, E 4496.22	ELEVATION AND DATUM: +12.7 feet, Mean Lower Low Water	
DRILLING CONTRACTOR: All Terrain Exploration Drilling	DATE STARTED: 2/10/1999	DATE FINISHED: 2/11/1999
DRILLING EQUIPMENT: Failing 1500	TOTAL DEPTH (feet): 95	MEASURING POINT: Top of asphalt
DRILLING METHOD: Mud Rotary	DEPTH TO FREE WATER FIRST ENCOUNTERED (feet): N/A	
SAMPLING METHOD: See boring log explanation, Figure B-1	DEPTH TO WATER AT COMPLETION (feet, date/time): N/A	
HAMMER WEIGHT: 140 pounds / HAMMER DROP: 30 inches	LOGGED BY: J. R. Wesling	

DEPTH (feet)	Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
0				ASPHALT			
				AGGREGATE BASE			
1				SILTY SAND (SM) Medium dense to dense, yellowish brown (10YR 5/4), minor subrounded gravel to 1/4 inch in upper 1 foot [FILL]			
2–3	1	S	450psi	Gray (2.5Y 5/1)			
4	2		6, 12, 18	SILTY CLAY (CL)			
5				SANDY CLAY (CL) Very stiff, yellowish brown (10YR 5/4), fine sand			
6					21.7	108.7	<200 = 59% Sieve
6.5	3	S	500psi	SILTY SAND (SM) Very dense, gray (2.5Y 5/1) mottled with brown (10YR 4/3), moist, fine subrounded sand			
8	4		17, 24, 30				<200 = 39% Sieve
10.5	5	P	80psi	CLAY with SAND (CL) Very stiff, gray (2.5Y 5/1), moist, very fine sand			
12.5	6		6, 11, 16				<200 = 80% Sieve LL = 33 PI = 11
13.5				- Few rootlets and plant fragments at 13.5 feet			
14.5					24.5 25.4	99.4 99.3	UU = 2.87 (1.80) Consol
15	7	P	75psi	SILTY SAND (SM) Very dense, yellowish brown (10YR 5/4), wet, occasional rounded gravel to 1/4 inch, fine sand at top, medium to coarse sand at bottom. Sand consists of quartz, feldspar, lithics [BEACH/EOLIAN DEPOSIT]			
17			17, 29		20.4		<200 = 14% Sieve

GT-1 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-1 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
18	8		38	SILTY SAND (SM): cont.			
19	9	P	80psi				
24				WELL GRADED SAND with SILT (SW-SM) Very dense, dark yellowish brown (10YR 4/4), wet, rounded gravel to 1-1/4 inches [BEACH]			
25			19				
26	10		27 27	More gravel	18.4		
28							<200 = 11% Sieve (Composite of Sample #10 and #11)
30			18				
31	11		27 33	Less gravel	14.1		
35				Gravel to 1 inch			
35			25				
36	12		36 42	POORLY GRADED SAND (SP)			
37–39							

GT-2 (7/99)

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-1 cont.

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	Dry Density (pcf)	Other
				WELL GRADED SAND with SILT (SW-SM): cont.			
40	13		33 50/3"	POORLY GRADED SAND (SP) Very dense, dark yellowish brown (10YR 4/4), moist, occasional gravel to 3/4 inch	16.9		
41							
42		P	35psi	- No recovery in pitcher sample			
43							
44				- Rounded gravel to 1/2 inch at 44 feet			
45							
46		P	45psi	- No recovery in pitcher sample			
47				Olive brown (2.5YR 5/3), wet, occasional rounded gravel to 1/4 inch, medium to coarse sand, subrounded to rounded			
48	14		36 50/3"				
49							
50	15		33 50/4"	Less gravel, medium grained sand	18.7		<200 = 5% Sieve
51							
52							
53							
54							
55	16		12 37 41	Fine subrounded sand consisting of quartz, feldspar, lithics			
56							
57							
58							
59							
60			20	Fine sand			

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-1 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
	17		50/5.5"	POORLY GRADED SAND (SP): cont.			
61							
62	18	P			21.2	106.4	<200 = 3% Sieve
63				- Medium sand, occasional rounded gravel, abundant lithics, feldspar, quartz			
64							
65	19		27 50/4"	WELL GRADED SAND with GRAVEL (SW) Very dense, olive brown (2.5Y 4/3), wet, medium to coarse sand			
66							
67							
68				Gravel lens			
69							
70	20		17 50/4.5"		10.2		<200 = 3% Sieve
71							
72							
73							
74				POORLY GRADED SAND (SP) Very dense, dark grayish brown (2.5Y 4/2), moist, fine sand, rounded, lithics, feldspar, quartz			
75	21		26 50/5.5"				
76							
77							
78				POORLY GRADED SAND (SP) Very dense, dark grayish brown (2.5Y 4/2), moist, fine to medium sand, rounded, lithics abundant, feldspar, quartz			
79							
80	22		42 50/4.5"		18.6		
81							
82							

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-1 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
				POORLY GRADED SAND (SP): cont.			
83							
84							
85							
86							
87							
88							
89							
90							
91							
92							
93							
94							
95				Bottom of boring at 95.0 feet. Boring backfilled with cement-bentonite grout.			

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

Log of Boring No. 99-2

PROJECT: HUMBOLDT BAY Independent Spent Fuel Storage Installation Humboldt County, California	
BORING LOCATION: N 9593.45, E 4715.90	ELEVATION AND DATUM: +40.6 feet, Mean Lower Low Water
DRILLING CONTRACTOR: All Terrain Exploration Drilling	DATE STARTED: 2/12/1999 — DATE FINISHED: 2/19/1999
DRILLING EQUIPMENT: Failing 1500	TOTAL DEPTH (feet): 420 — MEASURING POINT: Ground surface
DRILLING METHOD: Mud Rotary	DEPTH TO FREE WATER FIRST ENCOUNTERED (feet): N/A
SAMPLING METHOD: See boring log explanation, Figure B-1	DEPTH TO WATER AT COMPLETION (feet, date/time): N/A
HAMMER WEIGHT: 140 pounds — HAMMER DROP: 30 inches	LOGGED BY: J. R. Wesling

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	Dry Density (pcf)	Other
0				SILTY CLAY (CL) Soft, black (10YR 2/1), moist, organic [TOP SOIL]			
2	1	S	80psi	CLAYEY SAND (SC) Medium dense, reddish yellow (7.5YR 6/6), moist, fine sand, subrounded			
3					21.4	105.2	UU=1.74 (0.3)
4–5	2		5 9 10				
5.5				LEAN CLAY with SAND to SILT with SAND (CL-ML) Very stiff, light yellowish brown (10YR 6/4), moist	26.8	98.0	<200 = 77% Sieve LL = 39 PI = 15 ICU-TC
6.5			250psi				
7	3	S					
7.5			360psi		29.5	94.8	<200 = 77% Sieve LL = 45 PI = 21 UU = 1.98 (0.9)
9–10	4		3 9 18	CLAYEY SAND (SC) Medium dense, light brownish gray (2.5Y 6/2), moist, fine, subrounded sand, more clayey in upper 6 inches			
11					22.8	105.7	<200 = 23% Sieve
11.5	5	S	300psi				
12.5				SILT (ML) Stiff, gray (2.5Y 5/1), moist, fine sand increasing with depth			
13.5–14.5	6		4 6 8				
14					28.2	96.3	
14.5					28.4	96.2	<200 = 99% LL = 43 PI = 16 UU = 2.03 (2.00) Sieve ICU-TC Consol
15			110psi				
15.5					21.8	107.1	
16	7	S			29.6	93.5	
17			150psi				

GT-1 (7/99)

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
18	8		4, 8, 11	SILT (ML): cont.	24	102.1	UC = 3.01
19–20	9		6, 19, 33	LEAN CLAY to SILT (CL-ML) Hard, brown (7.5YR 5/4), moist	19	111.9	<200 = 86% Sieve LL = 31 PI = 9 UC = 13.99
25–26	10		6, 14, 22	SILTY SAND (SM) Very dense, light olive brown (2.5Y 5/3), moist, fine sand, subrounded to rounded			<200 = 31% Sieve
29				POORLY GRADED SAND with SILT (SP-SM) Very dense, light olive brown (2.5Y 5/3)			
30–31	11		36, 46, 50				<200 = 9% Sieve
33				POORLY GRADED SAND (SP) Very dense, light olive brown (2.5Y 5/3), moist, fine subrounded to rounded sand			
35	12		45, 50*/5.5"				
36–39							

GT-2 (7/99)

Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
				SILTY SAND (SM) Very dense, light olive brown (2.5Y 5/3), moist			
40							
41					17.4	111.5	<200 = 48% Sieve
	13	P	75psi				
42							
43							
44				WELL GRADED GRAVEL with SAND (GW) Dense, dark yellowish brown (10YR 4/4), wet, subrounded gravel to 1 inch (gravel plugged sampler)			
45			29				
46	14		27 17				
47							
48				SILTY CLAY (CL-ML) Hard, dark gray (2.5Y 5/1), moist			
49							
50			10				
51	15		20 30	CLAYEY SAND (SC) Dense, dark gray (2.5Y 4/1), moist			<200 = 32% Sieve
52							
53							
54							
55			31	WELL GRADED GRAVEL with SAND (GW) Dense, gravel to 1-1/2 inches			
56	41		50*/3" 50*/3"				
57							
58							
59				POORLY GRADED SAND with SILT (SP-SM) Very dense, olive brown (2.5Y 4/3), moist, fine sand			
60							

GT-2 (7/99)

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

Log of Boring No. 99-2 cont.

DEPTH (feet)	Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
61	16		23 35 43	POORLY GRADED SAND with SILT (SP-SM): cont.			<200 = 11% Sieve
62							
63							
64							
65	17		39 50"/5"				
66							
67							
68							
69				WELL GRADED SAND (SW) Very dense, olive brown (2.5Y 4/3), wet, rounded gravel to 1/2 inch			
70							
71	18	P	50psi		21.6	105.2	<200 = 2% Sieve
72							
73							
74							
75			50"/3.5" 50"/4"				
76							
77							
78				POORLY GRADED SAND with SILT (SP-SM) Very dense, olive brown (2.5Y 5/3), moist, medium grained sand, subrounded to subangular, gravel lenses, rounded gravel to 1/2 inch			
79							
80	19		89 100/6"				<200 = 8% Sieve
81							
82							

Log of Boring No. 99-2 cont.

DEPTH (feet)	Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
				POORLY GRADED SAND with SILT (SP-SM): cont.			
83							
84							
85							
86							
87							
88							
89							
90							
91							
92							
93							
94							
95							
96							
97							
98							
99							
100	20		76 101/6"	LEAN CLAY (CL): hard, light yellowish brown (10YR 6/4), moist			
101							
102							
103							

GEES-8/01 5117LOG...PJ GES91999 GDT 3/27/02

GT-2 (7/99)

Log of Boring No. 99-2 cont.

DEPTH (feet)	Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
104				POORLY GRADED SAND with SILT (SP-SM): cont.			
105							
106							
107							
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119				- More silty			
120	21		70/6"				
121							
122							
123							
124							
125							

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
				POORLY GRADED SAND with SILT (SP-SM): cont.			
126							
				POORLY GRADED SAND with GRAVEL (SP) Very dense, dark gray (2.5Y 4/1), wet, rounded gravel to 1-1/2 inches			
127							
128							
129							
130				- No recovery in pitcher sample			
131		P	25psi				
132							
133							
134							
135							
136							
137							
138							
139							
140	42		100"/3"				<200 = 3% Sieve
	22		138"/4.5"				
141							
142							
143							
144							
145							
146							

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
147				POORLY GRADED SAND with GRAVEL (SP): cont.			
148							
149							
150							
151							
152				LEAN CLAY to SILT (CL-ML) Hard, dark gray (2.5Y 4/1), moist, abundant shell fragments			
153			20				
154	23		43 50/5"				
155							
156	24	P	100psi		21.3	108.3	<200 = 98% Sieve LL = 35 PI = 14 Consol
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
				LEAN CLAY WITH SILT (CL-ML): cont.			
169							
170			26				
	25		34				
171			50				
172							
173							
174							
175							
176				LEAN CLAY (CL) Hard, dark gray (2.5Y 4/1), moist, some fine sand			
177							
178							
179							
180			35				
	26		50/5.5"				
181							
182							
183							
184							
185				SILT with SAND (ML) Hard, dark gray (2.5Y 4/1), moist, clayey, shell fragments			
186							
187							
188							
189							

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

Log of Boring No. 99-2 cont.

DEPTH (feet)	Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
190				SILT with SAND (ML): cont.			
199				SILT with SAND to LEAN CLAY with SAND (ML-CL) Very dense, dark gray (2.5Y 4/1), moist			
200–201.5	27		31 43 50/4.5"		26.7		<200 = 88% LL = 31 PI = 10 Sieve
211							

GT-2 (7/99)

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
				SILT with SAND to LEAN CLAY with SAND (ML-CL): cont.			
212							
213							
214							
215							
216							
				POORLY GRADED SAND with SILT (SP-SM) Very dense, gray (2.5Y 5/1), wet, subangular to subrounded, some small gravel layers			
217							
218							
219							
220	28		50*/5.5"	LEAN CLAY (CL)			
221							<200 = 7% Sieve
222	29	C					
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							

GT-2 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-2 cont.

DEPTH (feet)	Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
233				POORLY GRADED SAND with SILT (SP-SM): cont.			
234							
235							
236							
237							
238							
239				SILTY SAND (SM) Very dense, gray (2.5Y 5/1)			
240							
241							<200 = 43% Sieve
242	30	C					
243							
244							
245							
246							
247							
248							
249							
250							
251							
252							
253							
254							

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
				SILTY SAND (SM): cont.			
255							
256							
257							
258							
259							
260							
261							
262	43	C		POORLY and WELL GRADED SAND with GRAVEL (SP-SW) Very dense, dark greenish gray (10GY 4/1), wet, medium to coarse sand, rounded gravel to 1/4 inch, shells (silicified)			
263							
264							
265							
266							
267							
268							
269							
270							
271							
272							
273							
274							
275							

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
276				POORLY and WELL GRADED SAND with GRAVEL (SP-SW): cont.			
277							
278							
279				POORLY GRADED SAND with SILT (SP-SM) Very dense, dark greenish gray (10GY 4/1)			
280							
281	31	C					<200 = 8% Sieve
282							
283							
284							
285							
286							
287							
288							
289							
290							
291							
292							
293				Silt with fine sand lens			
294							
295							
296							
297							

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY Independent Spent Fuel Storage Installation Humboldt County, California	Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	Dry Density (pcf)	Other
				POORLY GRADED SAND with SILT (SP-SM): cont.			
298							
299							
300				WELL GRADED SAND with GRAVEL (SW) Very dense, dark greenish gray (10GY 4/1), wet, rounded gravel to 1/4 inch, minor interbedded poorly graded sand (SP)			
301							
	32	C					
302							
303							
304							
305							
306							
307							
308							
309							
310							
311							
312							
313							
314							
315							
316							
317							
318							

GT-2 (7/99)

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

Log of Boring No. 99-2 cont.

DEPTH (feet)	Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
319				WELL GRADED SAND with GRAVEL (SW): cont.			
320				POORLY GRADED SAND with SILT (SP-SM) Very dense, dark greenish grey (10GY 4/1), wet, fine sand			
321	33	C					
322							
323							
324							
325							
326							
327							
328							
329							
330				- Silt content variable, some layers of clean sand			
331	34	C					<200 = 11% Sieve
332							
333							
334							
335							
336							
337							
338							
339							
340							

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	Other
				POORLY GRADED SAND with SILT (SP-SM): cont.			
341	35	C					
342							
343							
344							
345							
346							
347							
348							
349							
350							
351							
352							
353							
354				Siltier			
355							
356							
357							
358							
359							
360				Less silty than above, may be transitional to poorly graded sand			
361		C					

GEES-B01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-2 cont.

DEPTH (feet)	Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
362	36	C		POORLY GRADED SAND with SILT (SP-SM): cont.			<200 = 7% Sieve
363							
364							
365				POORLY GRADED SAND with SILT (SP-SM) Very dense, dark greenish gray (5BG 4/1), wet, fine subrounded to rounded sand, harder weakly cemented zones			
366							
367							
368							
369							
370							
371	37	C					<200 = 7% Sieve
372							
373							
374							
375							
376							
377							
378							
379							
380							
381	38	C					
382							
383							

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-2 cont.

DEPTH (feet)	Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
				POORLY GRADED SAND with SILT (SP-SM): cont.			
384							
385							
386							
387							
388							
389							
390							
391	39	C					<200 = 9% Sieve
392							
393							
394							
395							
396							
397							
398				SILTY CLAY with SAND (CL-ML) Hard, dark greenish grey (10Y 4/1), moist, fine subrounded sand			
399							
400							
401	40	C		SILTY SAND (SM) Very dense, dark greenish grey (5G 3/1), moist			
402							
403							
404							

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY Independent Spent Fuel Storage Installation Humboldt County, California	Log of Boring No. 99-2 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
				SILTY SAND (SM): cont.			
405							
406							
407							
408							
409							
410							
411							
412							
413							
414							
415							
416							
417							
418							
419							
420				Bottom of boring at 420.0 feet. Boring backfilled with cement-bentonite grout.			

GT-2 (7/99)

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

PROJECT: HUMBOLDT BAY Independent Spent Fuel Storage Installation Humboldt County, California	Log of Boring No. 99-3
BORING LOCATION: N 9683.76, E 4788.95	ELEVATION AND DATUM: 42.92 feet Mean Lower Low Water
DRILLING CONTRACTOR: All Terrain Exploratory Drilling	DATE STARTED: 12/6/1999 / DATE FINISHED: 12/7/1999
DRILLING EQUIPMENT: CME 850	TOTAL DEPTH (feet): 77.3 / MEASURING POINT: Ground surface
DRILLING METHOD: Mud Rotary	DEPTH TO FREE WATER FIRST ENCOUNTERED (feet): N/A
SAMPLING METHOD: See boring log explanation, Figure B-1	DEPTH TO WATER AT COMPLETION (feet, date/time): N/A
HAMMER WEIGHT: 140 pounds / HAMMER DROP: 30 inches	LOGGED BY: J.R. Wesling

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	Dry Density (pcf)	Other
0–1.5	1		2, 4, 6	CLAY with SAND (CL) Stiff, brown (10YR 4/3), moist, low plasticity [FILL] CLAY (CL) Stiff, black (10YR 2/1), moist, low plasticity [TOP SOIL]			
1.5–4	2	S	300psi, 400psi, 500psi	SANDY CLAY (CL) Stiff, yellowish brown (10YR 6/6), moist, low plasticity [TERRACE]			
4–5.5	3		7, 8, 8	CLAYEY SAND (SC) Loose, strong brown (7.5YR 5/6), moist SANDY CLAY (CL) Very stiff, strong brown (7.5YR 5/6), moist, low plasticity	23.4	101.6	Sieve <200 = 57% LL = 30 PI = 7 UU = 2.0 (1.0)
5.5–7	4	S	250psi, 300psi, 400psi, 500psi	CLAYEY SAND (SC) Medium dense, grayish brown (2.5Y 5/2), moist, fine sand, rootlets			
7–8.5	5		6, 10, 14	SILTY SAND (SM) Medium dense, grayish brown (2.5Y 5/2), moist, fine sand, poorly graded			Sieve <200 = 40% LL = 23 PI = 0
9.5–11				SILT (ML) Becomes pale brown (10YR 6/3)			
11–17				CLAY (CL) Very stiff, dark greenish gray (10GY 4/1), moist, low plasticity [OLD BAY MUD]			
15–16.5	6		4, 10, 14		22.6	105.5	Sieve <200 = 94% LL = 32 PI = 9 UU = 2.2 (2.0)

GT-1 (7/99)

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-3 cont.

DEPTH (feet)	Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
18				CLAY (CL): cont.			
19–20				SILTY CLAY (CL-ML) Hard, brown (7.5YR 5/4), moist, low plasticity, fine sand			
20–21.5	7	X	11, 22, 23		23.0	104.5	Sieve <200 = 90% LL = 29 PI = 6 UU = 4.5 (2.5)
23				SILTY SAND (SM) Very dense, light olive brown (2.5Y 5/3), moist, fine subrounded sand, poorly graded, minor silt, CLAYEY SAND (SC) layers to 1/2 inch			
25–26.5	8		20, 30, 34				Sieve <200 = 35% LL = 19 PI = 0 UU = 6.9 (4.5)
30–31.5	9		23, 40, 43				Sieve <200 = 16% LL = 18 PI = 0
33				SILTY SAND (SM) Very dense, dark grayish brown (2.5Y 4/2), moist, fine subrounded sand, occasional clay laminae			
35–37.5	10	P	400psi to 500psi		15.0	110.2	Sieve <200 = 16% LL = 14 PI = 0 UU = 6.9 (4.5)
39							

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-3 cont.

DEPTH (feet)	Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
				SILTY SAND (SM): cont.			
40			18				Sieve <200 = 46% LL = 18 PI = 0
41	11		27, 30				
42							
43							
44				SILTY SAND (SM) Dense, dark greenish gray (5BG 3/1), moist, 1-inch thick SAND (SW) layer and 1/2-inch thick SILTY CLAY (SC-ML) layer			
45			18				Sieve <200 = 34% LL = 18 PI = 0
46	12		30, 19				
47							
48							
49							
50				SILT with SAND (ML) Very stiff, gray (2.5Y 5/1), moist, rootlets [OLD BAY MUD]			
51	13	P	500psi		21.1	106.6	Sieve <200 = 84% LL = 29 PI = 6 UU = 4.3 (5.5)
52			8				Sieve <200 = 88% LL = 31 PI = 7
53	14		10, 14				
54							
55			10	SILT (ML) Hard, gray (2.5Y 5/1), moist [OLD BAY MUD]	32.7	89.8	Sieve <200 = 99% LL = 47 PI = 17 UU = 2.8 (5.5)
56	15		20, 40	SANDY SILT with PEAT (MH)	113.4	38.6	Sieve <200 = 68% LL = 180 PI = 54 UU = 4.5 (5.5)
57							
58							
59				SAND with SILT and GRAVEL (SP-SM) Very dense, dark grayish brown (2.5Y 4/2), moist, poorly graded sand, rounded gravel to >1.5 inches			
60			25				

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-3 cont.

DEPTH (feet)	Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
	16		47	SAND with SILT and GRAVEL (SP-SM): cont.			
61			50/4"	Becomes brown (10YR 4/3) below 61 feet			Sieve <200 = 10%
62				GRAVEL with SAND (GW) Medium dense, mottled light olive brown (2.5Y 5/4) to very dark grayish brown (2.5Y 3/2), moist, well graded gravel, rounded gravel to 1"			
63							
64							
65			5				
66	17		12				
			32				
67							
68							
69							
70			14				
	18		44				
71			50/2"				
72							
73							
74							
75	19		28				
76	20		50/4.5"	GRAVEL with SAND (GP) Very dense, olive brown (2.5Y 4/3), moist, poorly graded sand			Sieve <200 = 1%
	21		15				
77			30				
			50/5.5"	Bottom of boring at 77.3 feet. Borehole backfilled with cement-bentonite grout.			

GEES-8/01 5117LOGS.GPJ GES91999 GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY Independent Spent Fuel Storage Installation Humboldt County, California	**Log of Boring No. 99-4**
BORING LOCATION: N 9711.29, E 4808.78	ELEVATION AND DATUM: 43.09 feet Mean Lower Low Water
DRILLING CONTRACTOR: All Terrain Exploratory Drilling	DATE STARTED: 12/7/1999 — DATE FINISHED: 12/8/1999
DRILLING EQUIPMENT: CME 850	TOTAL DEPTH (feet): 63 — MEASURING POINT: Ground surface
DRILLING METHOD: Mud Rotary	DEPTH TO FREE WATER FIRST ENCOUNTERED (feet): N/A
SAMPLING METHOD: See boring log explanation, Figure B-1	DEPTH TO WATER AT COMPLETION (feet, date/time): N/A
HAMMER WEIGHT: 140 pounds — HAMMER DROP: 30 inches	LOGGED BY: J.R. Wesling

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	Dry Density (pcf)	Other
0–1	1	X	3, 5, 6	SILTY CLAY (CL-ML) Stiff, very dark gray (10YR 3/1), moist, gravel to 1 inch [TOPSOIL]			
2–3	2	S	300psi, 400psi, 500psi	CLAY with SAND (CL) Stiff, yellowish brown (10YR 5/6) mottled with light gray (10YR 7/2), moist, low plasticity [B+ HORIZON?]			
3–4				SAND with CLAY (SW-SC) Medium dense, light yellowish brown (10YR 6/4), moist, well graded sand			
4–5	3		2, 3, 6	CLAY with SAND (CL) Stiff, light yellowish brown (10YR 6/4), moist, low plasticity, fine sand			
6	4	S					
6–8	5	X	12, 9, 7	CLAYEY SAND to SILTY SAND (SC-SM) Medium dense, yellowish brown (10YR 4/4), moist, grades to SILTY SAND (SM), medium dense			Sieve <200 = 25% LL = 19 PI = 0
8–10	6	S	400psi, 500psi	SILTY CLAY (CL-ML) Very stiff, greenish gray (5BG 5/1), moist, low to medium plasticity [OLD BAY MUD]	28.0	95.9	Sieve <200 = 99% LL = 37 PI = 12 UU = 2.3 (1.5)
13–16	7	X	8, 9, 9	SILT (ML-MH) Very stiff, greenish gray (5BG 5/1), moist, high plasticity [BAY MUD]	33.7	89.6	Sieve <200 = 100% LL = 50 PI = 21 UU = 1.0 (2.0)

GT-1 (7/99)

GEES-8/01 5117LOG.GPJ GES91999.GDT 3/27/02

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-4 cont.

DEPTH (feet)	Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
18				SILT (ML-MH): cont.			
19				SANDY SILTY CLAY (CL-ML) Hard, grayish brown (2.5Y 5/2) mottled with yellowish brown (10YR 5/4), moist, low plasticity [OLD BAY MUD]			
20–21	8		14, 18, 30		18.7	112.2	Sieve <200 = 75% LL = 28 PI = 7 UU = 5.1 (2.5)
23				SAND SILT (ML) Hard, olive brown (2.5Y 4/3), moist, poorly graded sand, clay binder			
25–26	9		6, 14, 24				Sieve <200 = 59% LL = 21 PI = 1
28				SAND with SILT (SP-SM) Very dense, olive brown (2.5Y 4/3), moist, fine sand			
30	10		57, [50/5"]		9.5	105.1	Sieve LL=15 PI=0 <200 = 11% ICU-TC
31			70, 68		8.1	104.8	Sieve <200 = 12% LL = 16 PI = 0 UU = 9.9 (4.0)
35–36	11		16, 20, 21	SANDY SILTY CLAY (CL-ML) Hard, olive brown (2.5Y 4/3), moist			Sieve <200 = 64% LL = 22 PI = 4
38–39				SILTY SAND (SM): See next page for description			

GT-2 (7/99)

GEES-B01 5117LOGS.GPJ GES91999.GDT 3/27/02

Log of Boring No. 99-4 cont.

DEPTH (feet)	Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other
				SILTY SAND (SM): cont. Dense, dark bluish gray (10BG 4/1), moist, poorly graded sand, large piece of wood in upper part of sample			
40	12		12, 31, 34		19.8	109.0	Sieve LL=16 PI=0 <200 = 24% ICU-TC
41					19.4	110.7	Sieve <200 = 25% LL = 17 PI = 0 UU = 8.5 (5.0)
42							
43				SILTY SAND (SM) Dense, very dark gray (5Y 3/1), moist, fine sand, contains wood fragments and peat			
44							
45	13		9, 19, 20				Sieve <200 = 35% LL = 23 PI = 0
46							
47							
48				SILTY SAND (SM) Very dense, very dark gray (5Y 3/1), moist, well graded, minor subrounded gravel to 1/4 inch, contains wood fragments and peat			
49							
50	14		30, 40, 50		21.0	105.5	Sieve LL=17 PI=0 <200 = 16% ICU-TC
51					20.3	106.1	Sieve <200 = 20% LL = 16 PI = NP UU = 5.6 (5.5)
52							
53				SILTY CLAY (CL-ML) Hard (?), dark greenish gray (10Y 4/1), moist			
54							
55	15		13, 18, 23	PEAT (OL) Very stiff			
56				SANDY CLAY with GRAVEL (CL) Hard, very dark grayish brown (2.5Y 3/2), moist, low plasticity, rounded gravel to 3/4 inch			
57				SAND with SILT and GRAVEL (SW-SM) Very dense, olive brown (2.5Y 4/3), moist, well graded sand, rounded gravel to 3/4 inch			
58							
59							
60			12				

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-4 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
	16		48	SAND with SILT and GRAVEL (SW-SM): cont.			
61			50/3"				Sieve <200 = 8%
			26				
62	17		48				
			50				
63				Bottom of boring at 63.0 feet. Borehole backfilled with cement-bentonite grout.			

GT-2 (7/99)

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

PROJECT: HUMBOLDT BAY Independent Spent Fuel Storage Installation Humboldt County, California	**Log of Boring No. 99-5**
BORING LOCATION: N 9651.23, E 4716.87	ELEVATION AND DATUM: 44.23 feet Mean Lower Low Water
DRILLING CONTRACTOR: All Terrain Exploratory Drilling	DATE STARTED: 12/8/1999 — DATE FINISHED: 12/9/1999
DRILLING EQUIPMENT: CME 850	TOTAL DEPTH (feet): 61.9 — MEASURING POINT: Ground surface
DRILLING METHOD: Mud Rotary	DEPTH TO FREE WATER FIRST ENCOUNTERED (feet): N/A
SAMPLING METHOD: See boring log explanation, Figure B-1	DEPTH TO WATER AT COMPLETION (feet, date/time):
HAMMER WEIGHT: 140 pounds — HAMMER DROP: 30 inches	LOGGED BY: J.R. Wesling

DEPTH (feet)	Sample No.	Sample	Blows/foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other (LABORATORY TESTS)
0–1.5	1	X	3, 4, 6	CLAY with SAND (CL) Stiff, very dark gray (10YR 3/1), moist, low plasticity [TOPSOIL]			
1.5–2.5	2	S	300psi, 400psi	CLAY with SAND (CL) Stiff, brown (10YR 3/4), moist [B+ HORIZON]			
2.5–4.5			500psi	CLAY with SAND (CL/CH) Very stiff, strong brown (7.5YR 5/6) mottled with light gray (10YR 7/2), moist, high plasticity [B+ HORIZON]			
4–5.5	3	X	5, 9, 10	becomes low plasticity (CL)	23.1	102.9	Sieve <200 = 66% LL = 38 PI = 19 UU = 2.5 (1.0)
5.5–7	4	S	300psi, 400psi				
7–10			500psi	CLAY (CL) Stiff, yellowish brown (10YR 5/6), moist, low plasticity			
8–9.5	5	X	8, 10, 15				
9.5–10	5	S					
10–11.5				SANDY SILT (ML) Very stiff, gray (N5), moist [OLD BAY DEPOSIT]			
11.5–15	6	S	400psi, 500psi	SILT (ML) Stiff to very stiff, dark greenish gray (10GY 4/1), moist [OLD BAY MUD]			
15–16.5	7	X	4, 6, 9		26.9	97.0	Sieve <200 = 94 LL = 37 PI = 12 UU = 2.3 (2.0)

GEES-8/01 5117L.GPJ GES91999.GDT 3/27/02

GT-1 (7/99)

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-5 cont.

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	Dry Density (pcf)	Other
18				SILT (ML): cont.			
20–21.5	8		5 12 20	becomes hard and brown (10YR 5/3) below 20.75 feet	22.7	104.0	Sieve 200 = 92% LL = 38 PI = 13 UU= 4.5 (2.5)
23				SILT (ML) Very stiff, light olive brown (2.5Y 5/3), moist, some clay binder			
25–25.7	9	S	500psi				
27				SILT (ML) Very stiff, dark gray (2.5Y 4/1) mottled with yellowish red (5YR 4/6) bands			
30–31.5	10		6 6 10				Sieve <200 = 92% LL = 31 PI = 5
33				SANDY SILT (ML) Hard, dark gray (2.5Y 4/1), minor fine sand			
35–36.5	11		11 18 20		25.8	100.0	Sieve <200 = 87% LL = 30 PI = 2 UU = 3.1 (4.5)
39							

GT-2 (7/99)

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

PROJECT: HUMBOLDT BAY
Independent Spent Fuel Storage Installation
Humboldt County, California

Log of Boring No. 99-5 cont.

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ foot	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	Other
				SANDY SILT (ML): cont.			
40	12		14, 16, 21	- some fine sand			Sieve <200 = 56% LL = 21 PI = 1
45	13		13, 16, 21	decrease in sand	34.2	88.0	Sieve <200 = 100% LL = 52 PI = 22 UU = 1.9 (5.0)
48.5				SILTY CLAY with SAND (CL-ML) Hard, dark gray (2.5Y 4/1), moist, some roots and wood fragments, some thin layers of fine sand			
50			8, 14, 13				
51.5	14		14, 21, 22		22.1	106.0	Sieve LL=25 PI=5 <200 = 73% UU=2.5(7.0)
54				SILT (MH) Hard, gray to dark gray (5Y4 5/1), moist, peat layers [OLD BAY MUD]			
55	15		9, 17, 31	PEAT	48.4	76.0	Sieve LL=67 PI=22 <200 = 90% UU=3.3(8.0)
59				SAND with GRAVEL (SW) Very dense, grayish green (5G 4/2), moist, well graded sand, rounded gravel to 1 inch			
60			60				

GEES-8/01 5117LO...PJ GES91999.GDT 3/27/02

GT-2 (7/99)

PROJECT: HUMBOLDT BAY Independent Spent Fuel Storage Installation Humboldt County, California	Log of Boring No. 99-5 cont.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other
			50/3"	SAND with GRAVEL (SW): cont.			
61	16		50 50/5"		13.3	125.1	
				Bottom of boring at 61.9 feet. Borehole backfilled with cement-bentonite grout.			

GT-2 (7/99)

GEES-8/01 5117LOGS.GPJ GES91999.GDT 3/27/02

ATTACHMENT 1

HUMBOLDT BAY ISFSI DATA REPORT B

ENERGY MEASUREMENT REPORT

GRL

Goble Rausche Likins and Associates, Inc.

March 12, 1999

Mr. Eric Chase
Geomatrix Consultants, Inc.
100 Pine Street, 10th Floor
San Francisco, CA 94111

Re: SPT Energy Measurements
February 10, 1999
PG&E, Humbolt Bay Power Plant
Eureka, CA

GRL Job No. 998006

Gentlemen:

This report presents the results of dynamic energy measurements taken during SPT sampling for soil boring GB99-1 for the above referenced project on February 10, 1999. GRL (Goble Rausche Likins and Associates, Inc.) made dynamic measurements with a PDA (Pile Driving Analyzer) at SPT sample depths ranging from 4 to 40 ft.

We understand that the primary test objective was to measure the energy transfer ratio (ETR) of the SPT system. The measured energy transfer ratio will be used to normalize the SPT N values to a standard efficiency of 60% (N_{60}). Our dynamic testing methods and equipment are described in Appendix A, the dynamic measurement results are presented in Appendix B, and calibration reports for our equipment are included in Appendix C.

DYNAMIC TESTING AND FIELD DETAILS

Drill Rig and SPT Hammer Description

The drilling and SPT sampling was performed by All-Terrain Inc using a Holemaster drill rig and APIF drill rod manufactured by Failing Exploration. It was reported to us that the APIF drill rod had a nominal diameter of 2 3/8 inches and a cross sectional area of 1.8 in². The hole was advanced using a mud-rotary drilling method. SPT sampling was performed at depth intervals of approximately 5 ft using a 140-lb safety hammer. The hammer operator, Ron Manley, used a rope and cathead with 2.5 wraps to operate the hammer with a nominal drop height of 30 inches. The safety hammer has a nominal rated energy of 350 ft-lbs. This rated energy value was used in computing the hammer energy transfer efficiency, ETR, that is presented in the dynamic test results. The total rod lengths below the dynamic test instrumentation, including the split spoon sampler, ranged from 9.0 ft to 44.0 ft during SPT sampling. Rod lengths and other information regarding the drilling operation are noted in the dynamic test results in Appendix B. For further information regarding the drill rig and hammers, please refer to the manufacturer's literature.

MAIN OFFICE: 4535 Renaissance Parkway • Cleveland, OH 44128 • (216) 831-6131 • Fax (216) 831-0916

CALIFORNIA	COLORADO	FLORIDA	ILLINOIS	NO. CAROLINA	PENNSYLVANIA	WASHINGTON
925-944-6363	303-666-6127	407-826-9539	847-670-7720	704-593-0992	610-459-0278	360-871-5480

Dynamic Test Instrumentation

Dynamic measurements of strain and acceleration were taken on a 2-ft long section of AW rod (Rod number 58) which was attached to the top of the SPT rod string, just below the hammer. Rod number 58 has a nominal cross sectional area of 1.2 in^2 and is instrumented with two strain bridges and two piezoresistive accelerometers. The calibration reports for the instrumented rod are included in Appendix C. By averaging the measurements taken from opposite sides of the rod, the effects of non-uniform hammer impacts to the recorded signals were minimized. Strain and acceleration signals were conditioned and converted to forces and velocities by a PAK Model, Pile Driving Analyzer® (PDA). This dynamic testing equipment is the same equipment that is routinely used for conventional pile driving analysis. The dynamic force and velocity records were the basis of the computed energy results presented in this report.

In the field the force and velocity records from the PDA were viewed on a graphic LCD screen to evaluate data quality. Further descriptions of the PDA equipment and theory are included in Appendix A.

DISCUSSION OF DYNAMIC TEST RESULTS

Calculation of Energy Transfer

The energy transferred to the instrumented rod section was computed from the dynamic force and velocity records by two different methods, EFV and EF2. The first method, EFV, uses both the force and velocity records to calculate the maximum transferred energy as:

$$EFV = \int F(t)V(t)\,dt$$

The integration is performed over the time period from which the energy transfer begins (non-zero) and terminates at the time when the energy transfer reaches a maximum value. This method is theoretically correct for all rod lengths regardless of the 2L/c stress wave travel time (L is the rod length and c is the stress wave speed in the rod) and the number of non-uniform rod corrections. This calculation is the method we use to compute the energy transfer ratio, ETR, which is computed as:

$$ETR = EFV \,/\, \text{Rated Hammer Energy}$$

The second method of computing energy transfer, EF2, uses only the force record in the calculation for the first 2L/c travel time and is computed as:

$$EF2 = c/EA \int [F(t)]^2 dt$$

where E is the Modulus of Elasticity of the rod, A is the rod cross sectional area, and c is the stresswave speed of the rod. In this equation the integration time starts at the hammer impact time and ends at the first occurrence of a zero force after impact. We report this method because it occurs in the original ASTM standard D4633-86 entitled "Standard Test Method for Stress Wave Energy Measurement for Dynamic Penetrometer Testing Systems", which is now expired. At the present time, the Revised Version of the ASTM D4633 standard is pending approval; however, there is no ASTM recognized standard for Energy testing at this time. We do not advocate use of the EF2 energy calculation method due to numerous errors associated with rod connections, rod non-uniformities, and rod length.

The original ASTM D4633-86 standard required that for the EF2 Method to be valid, the integration cut-off time and the first zero force must occur between 0.9[2L/c] and 1.2[2L/c]., where 2L/c is the travel time for an impact generated stress wave to travel from the sensors, down the rod string to the sampler tip and back. Data that does not meet these criteria should not be used. ASTM D4633-86 lists different empirical correction factors which should be applied to the equation to account for variations in rod length below and above the measurement location and to account for variations in theoretical versus measured stress wave velocity. The EF2 energy values we reported have not been corrected using the K factors described in ASTM D4633-86. Although we have presented the EF2 values to conform to the old ASTM standard, we do not advocate their use due to the many inaccuracies that are inherent in the computation. The EFV energy computation is preferred because it is valid for non-uniform rod cross sections and does not require corrections for variation in rod length.

Presentation of Dynamic Test Results

In addition to energy transfer (EFV) and energy transfer ratio (ETR), the PDA also computed values for the hammer blow rate (BPM), the maximum impact force (FMX), and the maximum rod velocity (VMX). These results are tabulated in Appendix B. For each sample depth interval the average, maximum, minimum, and standard deviation of each value is given along with final sample depth for each 1.5 ft sample interval, the field reported SPT blow count, N, the final blow number for each depth interval, and the sample number for each depth interval.

Hammer Performance

According to the EFV method, the average energy transfer from the safety hammer for all eight sample depth intervals was 173 ft-lbs and the average energy transfer efficiency was 49.4% of the rated energy. The average energy transfer for individual depth intervals ranged from 161 ft-lbs to 197 ft lbs and average transfer efficiencies ranged from 45% to 53%. These results indicate that the field observed SPT blow counts should be increased from 13% to 33% to normalize to field blow counts to standard efficiency of 60% (N_{60}). The reported SPT blow counts (N) ranged from 27 blows/ft to 50 blows/3 inches.

We appreciate the opportunity to be of assistance to you on this project. Please contact us if you have any questions regarding this report, or if we may be of further service.

Very truly yours,

GOBLE RAUSCHE LIKINS & ASSOCIATES, INC.

Steve Abe *(signature)*

Steven K. Abe, P.E.

APPENDIX A:

AN INTRODUCTION INTO DYNAMIC PILE TESTING METHODS

BACKGROUND

Between 1964 and 1977 research was conducted at Case Institute of Technology in Cleveland, Ohio with the objective of improving pile installation and construction control methods using electronic measurement and modern analysis methods. This work was supported by the Ohio Department of Transportation and the Federal Highway Administration.

In 1972, the research results were introduced into practice. Professor G. G. Goble, who had been the principal investigator at Case, founded Pile Dynamics, Inc. a company which manufactures - among other devices - the Pile Driving Analyzer® (PDA). Together with his former research assistants he also founded Goble Rausche Likins and Associates, Inc. (GRL) a consulting engineering firm specialized in the dynamic measurement and analysis methods of piles.

Pile Dynamics gradually improved the PDA technology, always searching for and utilizing advances in electronic and computer technology. In addition, new devices were built and introduced into the market. GRL, on the other hand, developed methods and software for the analysis of the measured quantities. It is the intent of this paper to summarize both analytical and measurement tools available to the civil engineer.

RESULTS FROM DYNAMIC TESTING

The following are the main objectives of dynamic pile testing (or monitoring).

- Bearing Capacity at the time of testing. For the prediction of a pile's long term bearing capacity, measurements are taken during restriking.
- Dynamic Pile Stresses during pile driving. In order to limit the possibility of pile damage, stresses must be kept within certain bounds.
- For concrete piles, both tension and compression stresses are important.
- Pile Integrity often must be checked both during and after pile installation.
- Hammer Performance must be checked for productivity and construction control.

MEASUREMENTS

The basis for the results calculated by the PDA are pile top force and velocity signals, obtained using accelerometers and bolt-on strain transducers attached to the pile near its top. The PDA conditions and calibrates these signals and immediately computes average pile force and velocity. Using Case Method solutions, the PDA calculates the results described in the following section.

Other measurements are sometimes also required. The ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™ (HPA). For open end diesel hammers, the time between two impacts indicates the magnitude of the fall height. This information is measured and calculated by the Saximeter™. Furthermore, the combustion pressure may be measured in diesels for proper wave equation modeling. Acceleration measurements taken on a helmet in addition to standard pile top force and velocity measurements yield pile top cushion stiffness information.

The Pile Integrity Tester™ (P.I.T.) can be used to evaluate damage to piles which may have occurred during driving or casting. It should also be mentioned that this so-called "Low Strain Method" of integrity testing requires only the measurement of acceleration at a pile top. The stress wave producing impact is then generated by a small hand-held hammer.

ANALYTICAL SOLUTIONS

BEARING CAPACITY

Wave Equation

GRL has prepared a program, GRLWEAP™, which provides for a truly analytical solution, *i.e.* it does not require measurements and provides the user with a functional relationship between both bearing capacity and pile stress and the blow count. These results can be adjusted or calibrated if measurements of pile top quantities are available. However, the real strength of the traditional wave equation approach lies in a prediction of driving behavior and in the selection of an optimal driving system.

Case Method

The Case Method is a closed form solution based on a few simplifying assumptions such as ideal plastic soil behavior and an ideally elastic and uniform pile. Given the measured pile top force F(t) and pile top velocity v(t), the total soil resistance is

$$R(t) = \frac{1}{2}\{[F(t) + F(t_2)] + Z[v(t) - v(t_2)]\} \quad (1)$$

where

- Z EA/c is the pile impedance (EA/c)
- t_2 time t + 2L/c
- L pile length below gages
- c $(E/\rho)^{1/2}$ is the speed of the stress wave
- E elastic modulus of the pile (ρc^2)
- ρ pile mass density
- A pile cross sectional area

The total resistance consists of a dynamic and a static component. Thus

$$R_s(t) = R(t) - R_d(t) \quad (2)$$

The static resistance component is, of course, the desired pile bearing capacity. The dynamic component may be computed from a soil damping factor, J, and a pile toe velocity, $v_t(t)$ which is conveniently calculated for the pile toe. Using wave considerations, this approach leads immediately to the dynamic resistance

$$R_d(t) = J[F(t) + Zv(t) - R(t)] \quad (3)$$

and finally to the static resistance by means of Equation 2. This solution is simple enough to be evaluated "in real time", *i.e.* between hammer blows, using the PDA. However, the assumption of a soil damping constant must be made and the time, t, has to be selected. Often, t is selected such that the maximum static resistance, RMX, is calculated. The damping constant, J, may not be needed if the time, t, is chosen such that the $R_d(t)$ term vanishes. One calls the resulting capacity value RA2.

CAPWAP®

This method (Case Pile Wave Analysis Program) combines the wave equation pile and soil model with the Case Method measurements. Thus, the solution includes not only the total and static bearing capacity values but also the skin friction, end bearing, damping factors and soil stiffness. The method iteratively determines a number of unknowns by signal matching. While it is necessary to make hammer performance assumptions for a GRLWEAP analysis, the CAPWAP program works with the pile top measurements. Furthermore, while GRLWEAP and Case Method require certain assumptions regarding the soil behavior, CAPWAP calculates these soil parameters.

STRESSES

The wave equation and CAPWAP solutions include stresses along the pile. For the PDA, field results include the pile top stress directly from the measurement and, for concentrated end bearing, the stress at the pile toe from Equation 1.

For concrete piles the maximum tension stress is also of great importance. It occurs at some point below the pile top. The maximum tension stress can be computed from the pile top measurements by considering the magnitude of both upward and downward traveling waves, W_u and W_d.

$$W_u = \frac{1}{2}[F(t) - Zv(t)] \quad (4)$$

$$W_d = \frac{1}{2}[F(t) + Zv(t)] \quad (5)$$

If any one of these waves is negative, a tension wave exists. It must be checked whether the wave traveling in the opposite direction is sufficiently compressive to reduce the net tension to allowable levels. The PDA also performs this calculation.

PILE INTEGRITY

High Strain Tests

Stress waves in a pile are reflected wherever the impedance (Z=EA/c) changes. The reflected waves arrive at the pile top at a time which depends on the location of the change. The reflected waves cause changes in both pile top force and velocity. The magnitude relative change of the pile top variables allows to determine the extent of the cross sectional change. Thus, with β_i being a relative integrity factor which is unity for no impedance change and zero for the pile end, the following can be calculated by the PDA.

$$\beta_i = (1 - \alpha_i)/(1 + \alpha_i) \qquad (6)$$

with

$$\alpha_i = \tfrac{1}{2}(W_{ur} - W_{ud})/(W_{di} - W_{ur}) \qquad (7)$$

where

W_{ur} is the upward traveling wave at the onset of the reflected wave. It is caused by resistance.

W_{ud} is the upwards traveling wave due to the damage reflection.

W_{di} is the maximum downward traveling wave due to impact.

Low Strain Tests (P.I.T.)

The pile top is struck with a held hand hammer and the resulting pile top velocity is measured, displayed and interpreted for signs of wave reflections. In general, a comparison of the reflected acceleration leads to a relative measure of extent of damage, again the location of the problem is indicated by the arrival time of the reflection. An approximate pile profile can be calculated from low strain records using the P.I.T.WAP.

HAMMER PERFORMANCE

The PDA can very simply calculate the energy transferred to the pile top.

$$E(t) = \int_0^T F(t)v(t)\,dt \qquad (8a)$$

The maximum of the E_t curve is the most important information for an overall evaluation of the performance of a driving system. This EMX or ENTHRU value allows for a classification of the hammer's performance, using:

$$e_t = EMX/E_r \qquad (8b)$$

where E_r is the hammer's rated energy.

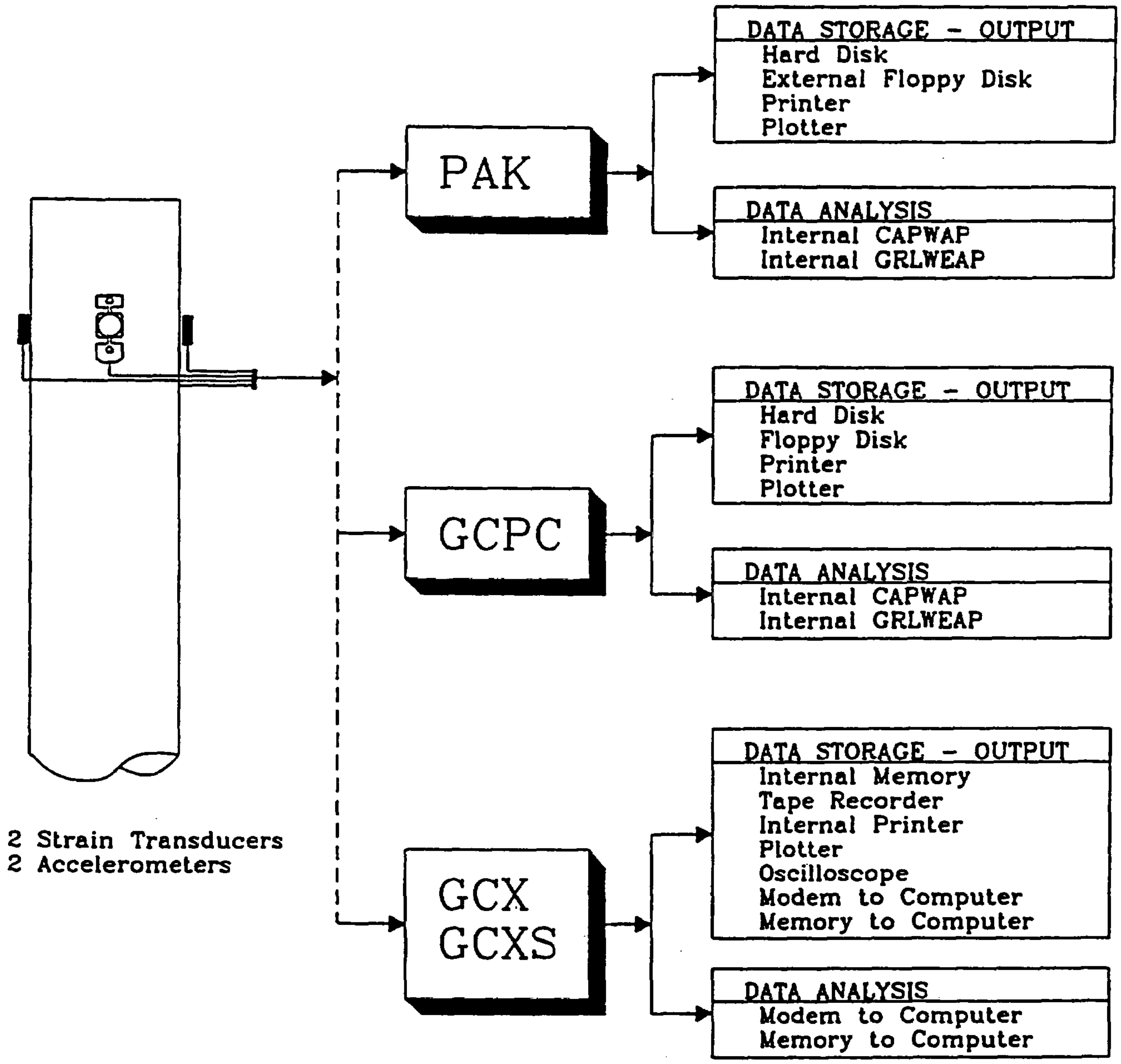
The Saximeter™ calculates the stroke from an open end diesel using

$$h = (g/8)\,T^2 - h_l \qquad (9)$$

where

- g earth gravitational acceleration,
- T time between two blows,
- h_l a stroke loss value due to gas compression and time losses during impact (usually 0.3 ft or 0.1 m).

Pile Driving Analyzer System



APPENDIX B

DYNAMIC MEASUREMENT RESULTS

EFV: Max Energy by F*V
ETR: Efficiency (EFV/Erated)
EF2: Energy by F^2 Method
VMX: Max Measured Velocity
FMX: Max Measured Force
BPM: Blows Per Minute

BL# end	N bl/ft	depth ft	TYPE	#Bls	EFV ft-lb	ETR %	EF2 ft-lb	VMX ft/sec	FMX kips	BPM bl/min
35	30*	5.50	AVG	34	171	48	292	8.8	33.0	44.6
			STD	34	17	5	25	0.4	2.2	1.3
			MAX	34	196	57	332	9.7	36.3	47.3
			MIN	34	130	37	216	7.9	26.2	41.4
80	54*	9.00	AVG	44	176	50	241	9.2	28.4	47.4
			STD	44	7	3	9	0.3	0.8	1.4
			MAX	44	189	54	257	9.8	30.1	49.6
			MIN	44	159	45	221	8.6	26.7	43.5
113	27*	13.50	AVG	32	180	51	290	9.6	30.3	45.6
			STD	32	14	4	21	0.5	1.4	0.9
			MAX	32	209	60	330	10.5	32.6	47.6
			MIN	32	151	42	250	8.6	27.8	44.0
194	67*	18.00	AVG	80	169	48	236	9.5	26.7	48.2
			STD	80	13	4	19	0.4	1.0	1.8
			MAX	80	192	54	269	10.4	28.7	51.0
			MIN	80	133	37	183	8.9	23.9	41.3
267	54*	26.50	AVG	72	161	45	293	8.2	31.0	44.0
			STD	72	7	2	13	0.4	0.8	1.1
			MAX	72	180	51	323	9.0	32.8	46.5
			MIN	72	146	42	264	7.4	28.8	40.5
342	60*	31.50	AVG	74	166	47	240	9.2	26.8	44.9
			STD	74	10	3	11	0.2	0.7	1.3
			MAX	74	188	54	277	9.9	28.9	47.5
			MIN	74	138	40	213	8.4	24.9	42.5
444	78*	36.50	AVG	101	178	50	272	8.7	28.4	41.2
			STD	101	11	3	27	0.3	2.2	3.1
			MAX	101	213	60	328	9.5	32.8	46.9
			MIN	101	156	45	221	8.1	24.7	36.1
524	200*	40.75	AVG	79	187	53	249	9.5	27.0	41.9
			STD	79	10	3	15	0.3	0.8	1.0
			MAX	79	213	60	282	10.2	28.6	45.3
			MIN	79	165	48	218	8.8	25.4	38.6

```
Notes:
*BLC USER INPUT
   BL#  COMMENTS

     1  BELOW LE=  9.0, LP=4.0-5.5

    35  BELOW LE= 14.0, LP=7.5-9.0
    80  BELOW LE= 19.0, LP=12.0-13.5
   113  BELOW LE= 24.0, LP=16.5-18.0
   194  BELOW LE= 29.0, LP=25.0-26.5
   267  BELOW LE= 34.0, LP=30.0-31.5
   342  BELOW LE= 39.0, LP=35.0-36.5
   444  BELOW LE= 44.0, LP=40.0-41.5
   524  REFUSAL @ LP=40.75, 50BL/3 INCHES

   DRIVE TIME SUMMARY (10-Feb-99 : GB99-1.Q00)           DRIVE          WAIT
   -------------------------------------------           ----- minutes  ----
   BN     1 ->    35, START 14:12:20 -> 14:13:05 STOP,    0.75
                                                                       34.07
   BN    36 ->    80, START 14:47:09 -> 14:48:05 STOP,    0.93
                                                                       28.87
   BN    81 ->   113, START 15:16:57 -> 15:17:39 STOP,    0.70
                                                                       23.70
   BN   114 ->   194, START 15:41:21 -> 15:43:01 STOP,    1.67
                                                                       63.42
   BN   195 ->   267, START 16:46:26 -> 16:48:05 STOP,    1.65
                                                                       17.23
   BN   268 ->   342, START 17:05:19 -> 17:06:58 STOP,    1.65
                                                                       18.43
   BN   343 ->   444, START 17:25:24 -> 17:27:52 STOP,    2.47
                                                                       22.23
   BN   445 ->   524, START 17:50:06 -> 17:51:59 STOP,    1.88
                                                  ---------------------------------
     Total Elapsed time 219.65 minutes      Total Time  11.70 minutes 207.95
```

APPENDIX C

SPT Rod Calibration Reports

Calibration Data Sheet for SPT rod #:58 AW
Calibrated: 12-Mar-99
Page 1 of 3

Cycle No. 1

Sample No.	lbs	ME	Bridge 1 Volts	Bridge 2 Volts
1	-.59	.00	.00	.00
2	1024.31	28.74	.12	.13
3	2136.81	60.33	.26	.27
4	3220.13	91.17	.40	.40
5	4242.89	120.19	.53	.54
6	5227.31	148.20	.66	.66
7	6163.19	173.53	.78	.78
8	7022.61	198.15	.89	.89
9	8118.81	228.74	1.03	1.03
10	9123.13	255.92	1.16	1.16
11	10095.26	284.33	1.28	1.29

Bridge 1	Force Cal	Strain Cal	Bridge 2	Force Cal	Strain Cal
Cal Factor	7638.22 lbs/V	220.30 ME/V		7801.63 lbs/V	219.47 ME/
Offset	59.80	1.94		45.20	1.53
Corr Coe	.999969	.999954		.999974	.999956

Force Strain Calibration
EA Factor 35547.44 Kips
Offset -9.18
Corr Coe .999993

Cycle No. 2

Sample No.	lbs	ME	Bridge 1 Volts	Bridge 2 Volts
1	-2.34	.00	.00	.00
2	1046.48	27.31	.13	.13
3	2049.06	55.06	.25	.26
4	3042.55	83.30	.38	.39
5	4124.75	113.31	.52	.52
6	5155.13	142.30	.65	.66
7	6088.04	168.97	.77	.77
8	7139.20	199.06	.90	.91
9	8172.81	227.87	1.04	1.04
10	9210.21	256.96	1.17	1.17
11	10111.21	282.35	1.29	1.29

Bridge 1	Force Cal	Strain Cal	Bridge 2	Force Cal	Strain Cal
Cal Factor	7643.69 lbs/V	219.97 ME/V		7569.08 lbs/V	220.67 ME/
Offset	39.50	-.64		-2.08	-1.80
Corr Coe	.999991	.999985		.999995	.999964

Force Strain Calibration
EA Factor 35657.14 Kips
Offset 62.59
Corr Coe .999969

Calibration Data Sheet for SPT rod #:56 AW
Calibrated: 12-Mar-98
Page 2 of 3

Cycle No. 3

Sample No.	lbs	ME	Bridge 1 Volts	Bridge 2 Volts
1	-7.61	.02	.00	.00
2	1204.22	32.34	.15	.15
3	2119.54	58.63	.27	.27
4	3073.14	84.20	.39	.38
5	4133.70	116.04	.53	.53
6	5196.25	145.72	.66	.66
7	6048.63	169.21	.77	.77
8	7082.20	198.35	.90	.90
9	8026.78	224.51	1.03	1.03
10	9111.58	253.77	1.16	1.17
11	10252.56	285.71	1.31	1.31

Bridge 1	Force Cal	Strain Cal	Bridge 2	Force Cal	Strain Cal
Cal Factor	7808.47 lbs/V	218.02 ME/V		7802.03 lbs/V	217.84 ME/
Offset	20.77	.37		19.03	.32
Corr Coe	.999991	.999969		.999992	.999969

Force Strain Calibration
EA Factor 35813.41 Kips
Offset 7.70
Corr Coe .999975

Bridge Excitation: 6.4 Volts
A 60.4K Ohm shunt resistor produces 5.0 Volts output.

	Bridge 1	Bridge 2
Calibration Factor:	219.49 ME/V	219.33 ME/V
EA Factor :	35672.65 Kips	

Calibrated by: Paul T. Richer
Paul T. Richer

Calibrated on: 12-Mar-98
Traceable to N.I.S.T.

The calibration data furnished herein (the "Calibration Data") was obtained using load cells that were calibrated according to traceable N.I.S.T. standards. Thomas P. Kicher & Co. makes no representations and gives no advice as to the use of the Calibration Data or the use of any equipment calibrated using the Calibration Data. Thomas P. Kicher & Co. is providing no professional, engineering or other advice or services other than obtaining the Calibration Data.

THE LIABILITY OF THOMAS P. KICHER & CO. AS TO THE CALIBRATION DATA SHALL BE LIMITED TO, AT THE SOLE CHOICE OF THOMAS P. KICHER & CO., EITHER (1) RECALIBRATION OF THE DEVICE CALIBRATED BY THE CALIBRATION DATA OR (2) A REFUND OF THE FEE PAID FOR THE CALIBRATION OF THAT DEVICE. UNDER NO CIRCUMSTANCES SHALL THOMAS P. KICHER & CO. BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OR FOR LOST PROFITS.

USE OF THE CALIBRATION DATA CONSTITUTES ACCEPTANCE OF THE ABOVE TERMS AND CONDITIONS.

TOTAL P.04