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DOCKET
06-AFC-7
DATE JAN 12
RECD. JAN 12 2007

January 12, 2007

Mr. John Kessler
Project Manager
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

Re: Applicant's Responses to CEC Staff Data Requests 1-57
Humboldt Bay Repowering Project (06-AFC-07)

Dear Mr. Kessler:

Attached are an original and 12 copies of Pacific Gas and Electric Company's responses to California Energy Commission Staff Data Requests 1 through 57 for the Application for Certification for the Humboldt Bay Repowering Project (06-AFC-07).

If you have any questions about this matter, please contact me at (916) 286-0278 or Susan Strachan at (530) 757-7038.

Sincerely,

Douglas M. Davy, Ph.D.
AFC Project Manager

Attachment

cc: G. Lamberg
S. Strachan
S. Galati

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA

APPLICATION FOR CERTIFICATION FOR THE HUMBOLDT POWER PLANT PROJECT	Docket No. 06-AFC-7 PROOF OF SERVICE

INSTRUCTIONS: All parties shall 1) send an original signed document plus 12 copies OR 2) mail one original signed copy AND e-mail the document to the web address below, AND 3) all parties shall also send a printed OR electronic copy of the documents that shall include a proof of service declaration to each of the individuals on the proof of service:

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DECLARATION OF SERVICE

I, Sarah Madams, declare that on January 12, 2007, I deposited copies of the attached Response to Data Requests, 1 through 57 in the United States mail at Sacramento, California with first class postage thereon fully prepaid and addressed to those identified on the Proof of Service list above. I declare under penalty of perjury that the foregoing is true and correct.

SL Madams

Sarah Madams

Supplemental Filing

Response to Data Requests
1 through 57

In support of the

Application for Certification

for the

Humboldt Bay Repowering Project

Eureka, California
(06-AFC-7)

Submitted to the:
California Energy Commission

Submitted by:

Pacific Gas and Electric Company™

With Technical Assistance by:

CH2MHILL

Sacramento, California
January 2007

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Introduction

Attached are Pacific Gas and Electric Company (PG&E) responses to the California Energy Commission (CEC) Staff's data requests numbers 1 through 57 for the Humboldt Bay Repowering Project (HBRP) (06-AFC-7). The CEC Staff served these data requests on December 8, 2006, as part of the discovery process for the HBRP project. The responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as CEC Staff presented them and are keyed to the Data Request numbers (1 through 57). New or revised graphics or tables are numbered in reference to the Data Request number. For example, the first table used in response to Data Request 15 would be numbered Table DR15-1. The first figure used in response to Data Request 28 would be Figure DR28-1, and so on.

Additional tables, figures, or documents submitted in response to a data request (supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of a discipline-specific section and are not sequentially page-numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

PG&E looks forward to working cooperatively with CEC Staff as the HBRP proceeds through the siting process. We trust that these responses address the Staff's questions and remain available to have any additional dialogue the Staff may require.

Air Quality

Data Responses 1-18

Air Quality (1-18)

PM10 and PM2.5 emission limit

1. *Please analyze a more-stringent PM10 and PM2.5 emission limit (e.g., develop a factor based on 0.02 g/bhp-hr during natural gas firing with an additional emission factor to account for diesel pilot fuel heat input) to minimize PM10/2.5 impacts.*

Response: PG&E requested and received guaranteed PM_{10} emission rates from Wärtsilä and has used these guaranteed emission rates to represent both PM_{10} and $PM_{2.5}$ emissions from the engines in analyzing the air quality impacts of the proposed project. While PG&E believes it is reasonably foreseeable that the PM_{10} and $PM_{2.5}$ emissions will not be as high as the levels guaranteed by Wärtsilä, and, in fact, expects that the actual emissions will be much lower than these levels, PG&E cannot accept any permit condition limiting emissions to levels that are not guaranteed.

The applicant believes that there is no technical basis for developing a PM_{10} / $PM_{2.5}$ emission limit for these engines based on a 0.02 g / bhp-hr emission rate. The emission guarantee provided by Wärtsilä for the 50DF (dual fuel) engines when operating on natural gas is the same, on a g / bhp-hr basis, as the emission rates proposed by the Applicant in another proceeding for the 34SG (spark-ignited) engines: approximately 0.097 g / bhp-hr. The particulate emission guarantee for the HBRP project does not reflect an allowance for diesel pilot fuel input, but it does reflect variability in test results. Please see DR2 for additional information regarding emission test variability. If the Staff is asking PG&E to identify and evaluate likely PM_{10} emission rates that would be lower than the maximum allowable emission rates, then PG&E would be willing to discuss such an evaluation but cannot accept such a permit condition.

Existing installations

2. *Please identify other existing installations of natural-gas fired, diesel-pilot compression ignition engines, identify the owner and manufacturer of the engines, and summarize any available information on particulate matter emission test results. This information should be focused on other installations of the proposed Wartsila engines.*

Response: There are currently no installations of the Wärtsilä 50DF (dual fuel) engines in the United States. There is one 50DF installation at a power plant in Turkey (owned by Manisa Ticaret Sanayi Odasi Organize Sanayi Bölgesi) and one installation on an LNG carrier owned by Gaz de France. Both projects were completed in 2005, and neither has been required to test for particulate emissions performance.

The University of California Santa Cruz has a Transamerica Delaval Enterprise Model DGSR.46 dual-fuel engine, rated at 3656 BHP (2.6 MW output). Particulate emissions testing was performed on this engine in 2002 and 2005. The test data are summarized below. The engine has no permitted particulate limits.

	2002 Test Result	2005 Test Result
Front Half Particulate Emissions, g/bhp-hr	0.1546	0.005
Total Particulate Emissions, g/bhp-hr	0.1975	0.020

The average load during the 2002 test was 2350 kW, or 89 percent load. The average during the 2005 test was not given, but was estimated based on the stack gas volumetric flow to be 2036 kW, or approximately 79 percent load. Both sets of tests were performed when the engine was fueled primarily on natural gas, with approximately 1 percent pilot diesel fuel. Both sets of tests used Method 5 for the front half. The 2002 tests used Method 5 for the back half and the 2005 tests used Method 202 for the back half. The test reports do not indicate that any inlet sizing was used to restrict the results to PM_{10}, so they represent total particulate as collected in the Method 5 sampling train. These results illustrate the variability of the particulate test results

Airborne toxic control

3. *Please provide a description of ATCM requirements (Cal. Code Regs., tit 17, §93115) assuming that the Wartsila engines satisfy the ATCM definition of "compression ignition engine." Please note whether reporting requirements would apply, if emission limitations are found to be non-applicable.*

Response: A description of the ATCM requirements and an analysis of the applicability of those requirements were provided in Section 8.1.5.2.2.2 of the AFC (pages 8.1-67 through 8.1-70). The Air Resources Board has concurred with the regulatory interpretation presented in the AFC. A copy of ARB's letter of concurrence is provided as Attachment DR3-1.

ARB's letter indicates that the requirements of the ATCM are <u>not</u> applicable when the engines are operating in natural gas/diesel pilot mode. Therefore no ATCM-related reporting requirements would apply during this operating mode.

ARB's letter also indicates that the requirements of the ATCM for Emergency Standby Engines <u>are</u> applicable when the engines operate in diesel-only mode. Therefore the requirements of (e)(2)(F)(4)(I) will apply, as follows:

> "…each owner or operator of an emergency standby diesel-fueled CI engine shall keep a monthly log of usage that shall list and document the nature of use for each of the following:
>
> a. emergency use hours of operation;
>
> b. maintenance and testing hours of operation;
>
> c. hours of operation for emission testing to show compliance with subsections (e)(2)(A)3. and (e)(2)(B)3.;
>
> d. initial startup hours;
>
> e. if applicable, hours of operation to comply with the requirements of NFPA 25;

f. hours of operation for all uses other than those specified in subsections (e)(4)(I)1.a through (e)(4)(I)1.d. above…"

Interruptible natural gas supply

4. *Please clarify whether HBRP would be an "interruptible" natural gas customer and what steps would need to be taken to ensure that deliveries of natural gas to HBRP are "uninterruptible." As part of this response, please clarify whether HBRP would have the same status as a "core customer" of natural gas.*

Response: PG&E's gas operations, including deliveries to PG&E-operated power plants such as Humboldt Bay Power Plant and HBRP, are governed by tariffs approved by the California Public Utilities Commission. These tariffs can be found at the following web site:

www.pge.com/tariffs

Gas Rule 1 contains definitions that apply to PG&E's gas tariffs. The definition of Noncore End-Use Customer includes the following provision:

> "Electric Generation, Enhanced Oil Recovery, Cogeneration, and Refinery Customers with historical or potential annual use exceeding 250,000 therms per year or rated generation capacity of five hundred kilowatts (500 kW) or larger, are permanently classified as Noncore End-Use Customers."

Based on this definition, the existing Humboldt Bay Power Plant is permanently classified as a Noncore End-Use Customer, and the new HBRP will be similarly classified. As a Noncore End-Use customer, Humboldt Bay Power Plant and HBRP have interruptible gas supplies; there are no discretionary actions that PG&E can take to ensure that deliveries of natural gas to HBRP will be "uninterruptible" under these tariffs, and it is unlikely that the CPUC would grant an exemption for HBRP. This is particularly true given the fact that HBRP will consume approximately 30 percent less fuel to support the same megawatt generating load as the existing Humboldt Bay Power Plant, thus relieving some of the current demand on gas supplies in northwestern California. This is discussed further in the response to Data Request 5.

Diesel fuel use

5. *Please clarify the circumstances that would lead to diesel fuel use. For example, AFC Section 6.1.1 shows that the existing power plant is required by CPUC Tariff to reduce gas usage and switch to backup fuel when average temperature drops below 50 °F, but it is not clear whether this requirement could be relaxed with the proposed project. Staff is interested in the feasibility of the CPUC considering and adopting revisions to the Tariff in order to minimize the number of hours of plant operation on backup fuel.*

Response: The discussion in Section 6.1 of the AFC was not intended to suggest that gas curtailment to Humboldt Bay Power Plant occurs at any time when ambient temperatures drop below 50°F. Gas curtailment proceeds in accordance with the provisions of Gas Rule 14, which specifies the order in which noncore gas customers may have their supplies curtailed. Neither Gas Rule 14, nor any other tariff, specifies an ambient temperature below which curtailment occurs. The purpose of the discussion in Section 6.1 of the AFC was to indicate that, in the Humboldt area, gas curtailments generally occur during cold weather

conditions, characterized by average daily temperatures of less than 50°F. The actual determination as to whether gas supplies to Humboldt Bay Power Plant need to be curtailed (and whether gas supplies to HBRP would need to be curtailed in the future) on any single day depends on the forecast for electrical demand and dispatch issued by the California Independent System Operator (CAISO) and the forecast for natural gas consumption prepared by PG&E. These forecasts are made daily, and are dependent on weather conditions as well as other factors. Consequently, no revisions to the tariff would address this issue.

As an example of how the need for curtailments is determined, it is instructive to look at the curtailment that occurred on the date of the Commission's Informational Hearing and Site Visit, December 18, 2006. At approximately 8 am on the previous day (December 17), the Humboldt Bay Power Plant received notification from PG&E's gas department of the hourly forecast of natural gas available from the gas line to the plant, combined with the expected gas use by Humboldt Bay Power Plant based on CAISO's day-ahead hourly generation forecast for the plant. The quantity of gas available to the plant is determined by PG&E's gas department, based on the forecast capacity of the serving pipeline and the forecast demand from other customers. The expected hourly gas use for HBPP is based on a heat-rate curve for the two steam units, which ranges from approximately 12,000 Btu / kWh at full load to approximately 22,000 Btu / kWh at minimum load (6 MW). This forecast was updated at approximately 8 am on December 18; the updated forecast is shown in Attachment DR5-1.

As seen in the forecast, Humboldt Bay Power Plant was forecast to have a shortage of natural gas to meet CAISO's forecast electrical demand for a total of 17 hours on December 18. To address this forecast shortage, PG&E started the Mobile Electric Power Plants (MEPPs) at 8:56 am on December 18, thus shifting approximately 30 MW of generating load to these diesel-fueled units, and away from the gas-fired steam units. This was sufficient to address the projected shortage on this day. In all, approximately 342 MWhrs of electricity were produced using backup (diesel) fuel on December 18, or 22 percent of the total 1549 MWhrs produced by Humboldt Bay Power Plant on that day.

As an example of the change that PG&E expects to see using the new generating units, Attachment DR5-2 shows the same forecast, but with the plant's expected natural gas consumption based on the worst-case heat rate for the Wärtsilä generating units. This worst-case heat rate for the Wärtsilä engines is 9,556 Btu / kWh (HHV), which occurs under cold ambient conditions at 50 percent engine load. As shown in Attachment DR5-2, no gas curtailment would have been required on December 18 had the new plant been in operation.

While some curtailments will undoubtedly be required in the future, this example demonstrates the role that the HBRP is expected to play in improving the gas supply situation in northwestern California.

Fuel supply reliability

6. *Given the inability to predict natural gas shortages or ensure deliveries of natural gas to HBRP, please describe what actions could be taken to improve the reliability of the natural gas fuel supply. For example, consider and describe the feasibility of natural gas storage options.*

Response: PG&E is a large company that is regulated by the Public Utilities Commission. The Applicant seeking a license for the HBRP before the CEC is the Generation Division of PG&E, which is regulated under the provisions of the law pertaining to electricity generation. Similarly, the Gas and Transmission divisions of PG&E are regulated under separate legal frameworks, making it not possible for the Generation Division to consider gas transmission development projects. However, as discussed in the response to Data Request 5, the construction and operation of HBRP will improve the reliability of the natural gas supply in northwest California because of the HBRP's increased fuel efficiency, compared with the existing plant. PG&E believes that additional measures, such as natural gas storage options, are beyond the scope of a reasonable alternatives analysis and are not within the purview of the entity within PG&E that has applied for CEC certification. Additionally, PG&E believes that it has demonstrated in the AFC that there would be no unmitigated significant adverse environmental impacts from construction or operation of the HBRP. Therefore, such an alternatives analysis is not required under CEQA. However, PG&E is willing to discuss this issue further at a data response workshop to better understand how such an analysis would facilitate the staff's review of the HBRP.

Natural gas shortfall

7. *Please describe the actions that HBRP would take (such as a variance request, an authorization of non-compliant operation, or additional air quality mitigation) if there is a shortfall of natural gas supplies for a prolonged period and the reciprocating engines are forced to operate on diesel fuel for more than 800 hours per engine per year.*

Response: As noted in Section 8.1 of the AFC, PG&E has calculated worst-case annual emissions for PSD purposes, which would be expected to be imposed as a federally enforceable permit condition, based on an assumed worst-case of 800 hours of full-load operation on diesel fuel for each of the ten engines in any year. This worst-case emission rate assumption would be the equivalent of 1,191,200 MMBtu / year of operation on diesel fuel. As shown in Table DR7-1, this value is higher than the quantity of liquid fuel used at Humboldt Bay Power Plant for all reasons during the last ten years, with the exception of 2001.

TABLE DR7-1
Liquid Fuel Consumption at HBPP (MMBtu/year)

	Boilers	MEPPs	Total
HBRP Proposed			1,191,200
2005	0	175,583	175,583
2004	0	192,472	192,472
2003	5,496	230,932	236,428
2002	4,475	117,539	122,014
2001	2,665,729	281,249	2,946,978
2000	147,495	489,771	637,267
1999	0	134,482	134,482
1998	8,297	73,479	81,777
1997	0	16,306	16,306
1996	130,325	53,665	183,990

TABLE DR7-1
Liquid Fuel Consumption at HBPP (MMBtu/year)

	Boilers	MEPPs	Total
1995	398,104	27,944	426,048
1994	11,225	24,978	36,203
1993	137,725	9,694	147,419

Most of the oil burning shown in the table, including the oil burned in 2001, occurred due to factors other than natural gas shortfall, many of which will be prohibited under the proposed permit:

> 1996: Oil was burned to reduce inventory below one million gallons due to an environmental regulatory limit on the on-site storage of residual oil. This cannot occur at HBRP because the liquid fuel to be used is distillate that is not subject to the residual oil storage regulation that applies to the existing plant.
>
> 1998: Oil was burned due to natural gas curtailment.
>
> 2000-2001: Oil was burned due to the high price of natural gas. This cannot occur with HBRP because liquid fuel operation of the reciprocating engines will be allowed only under emergency conditions, and economic dispatch will not be an allowable emergency condition.
>
> 2002 and 2003: Oil was burned due to work on a plant boiler gas valve. While this could occur at HBRP because liquid fuel can be used during maintenance activities, this was not the result of a gas curtailment.

The remaining liquid fuel consumption shown in Table DR7-1 was for the MEPPs. These units can only burn liquid fuel, and liquid fuel consumption in these units was attributable to the following reasons:

- Maintenance and testing activities
- Operation required to meet local electrical loads
- Operation to avoid gas curtailment of the steam boilers

Given that the HBRP will reduce gas consumption for electric power generation at the site by 30 percent or more, and thus increase the electrical load that can be served without the need for curtailment by more than 50 percent, it is very unlikely that the proposed emission rates (based on 800 hours of full-load operation on 100 percent liquid fuel) would be exceeded during any year. For this reason, we do not anticipate the need for a variance request, authorization for non-compliant operation, or additional mitigation.

Local electrical reliability requirements

8. *Please describe the actions that HBRP would take (such as a variance request, an authorization of non-compliant operation, or additional air quality mitigation) if there is a need to operate HBRP at an annual capacity factor of greater than 70 percent to satisfy local electrical reliability requirements.*

Response: It is very unlikely that there would be a need to operate the HBRP at an annual capacity factor of greater than 70 percent. PG&E elected to evaluate emissions based on a 70 percent capacity factor in order to be very conservative in its environmental impact analysis, but does not intend to operate the HBRP at or above this capacity factor. The HBRP is designed as a 163 MW plant to meet peak short-term loads. To put the existing electrical loads that the plant will serve in perspective, the year average load factor for the existing Humboldt Bay Power Plant is 35 percent of the HBRP's maximum allowable generation. A 70 percent capacity factor would allow HBRP to generate up to approximately one million MWhrs of electricity. In comparison, the highest total generation in the past 10 years from the Humboldt Bay Power Plant was approximately 700,000 MWhrs in 2001—only 70 percent of what is being proposed as the maximum annual generation from the new plant (see Figure DR8-1). Based on this historical record and 20 percent increase in capacity associated with HBRP as compared with the existing plant, PG&E does not anticipate that compliance with the proposed annual emission limits (which are based on an assumed 70 percent annual capacity factor) will present any restrictions that warrant the need to seek a variance from the NCUAQMD.

NOx at startup

9. Please describe how NOx would be limited during startups to less than 830 lb/hr, including a black start emergency condition of ten engines starting on diesel fuel simultaneously.

Response: The maximum hourly emission rate for starting up each reciprocating engine on liquid fuel was calculated assuming a cold start requiring 30 minutes, followed by 30 minutes of full-load operation at the permitted NOx emission limit. There are several levels of conservatism built into the worst-case hourly emission rate for each engine that allows PG&E to commit to limiting total hourly NOx emissions to no more than 830 lb/hr. Under most conditions, the NOx emission control systems for the engines will reach their full abatement efficiency in less than 30 minutes, so that the actual pounds of NOx per start will be less than the 154 lb/hr shown in Table 8.1-16. NOx emissions from the engines will be continuously monitored to ensure that the proposed hourly limit is not exceeded.

Number of daily startups

10. Please discuss whether permit conditions would be used to limit the number of daily startups.

Response: PG&E is not proposing to use permit conditions to limit the number of daily startups. PG&E will comply with facility-wide daily emissions limits that were developed based on an assumed number of daily startups, but to maximize operating flexibility, no limits on the number of startups per day are proposed.

Emission reduction credits

11. Please identify and describe the following:

a. Sources of the offsite ERCs for NOx, VOC, and PM10;

b. Any ERCs held by the applicant to be used for HBRP; and

c. Status of the negotiations.

Response: PG&E is currently in negotiations with an industrial facility to purchase emission reduction credits which were created from the shutdown and surrender of Permits to Operate of emissions units. These negotiations near conclusion and are confidential at this time. Once the transaction is executed, PG&E will supplement this response with the specific information requested by the staff. If the transaction is not concluded within 30 days, the information will be submitted under a request for confidentiality.

Dispersion modeling scenario

12. *Please prepare a dispersion modeling scenario to evaluate simultaneous operation of the existing HBPP while HBRP construction takes place. Please provide the air dispersion modeling files in CD format.*

Response: The requested modeling analysis has been prepared, and the input and output files are provided on the enclosed CD. To make this analysis consistent with the HBRP construction impacts analysis provided in the AFC, ISCST3 has been used for the analysis. The results of the analysis are provided in Table DR12-1. The results indicate that there will be little or no overlap between the impacts from the two activities.

TABLE DR12-1
Combined Impacts of Humboldt Bay Power Plant Operation and HBRP Construction

Pollutant/ Averaging Period		Humboldt Bay Power Plant Operation Alone[a] ($\mu g/m^3$)	HBRP Construction Alone[b] ($\mu g/m^3$)	Humboldt Bay Power Plant Operation and HBRP Construction[b] ($\mu g/m^3$)
NO_2 –	1 hour	267.3	227	227
	annua[lc]	9.1	20	20
SO_2 –	1 hour	10.0	3	38.4
	24 hour	2.6	0.3	2.6
	annual	0.04	0.04	0.05
CO –	1 hour	110.3	5,231	5,231
	8 hour	55.1	1,138	1,138
PM_{10} –	24 hour	7.8	27	27
	annual	0.3	3	3
$PM_{2.5}$ –	24 hour	7.8	8	10.3
	annual	0.3	1	1

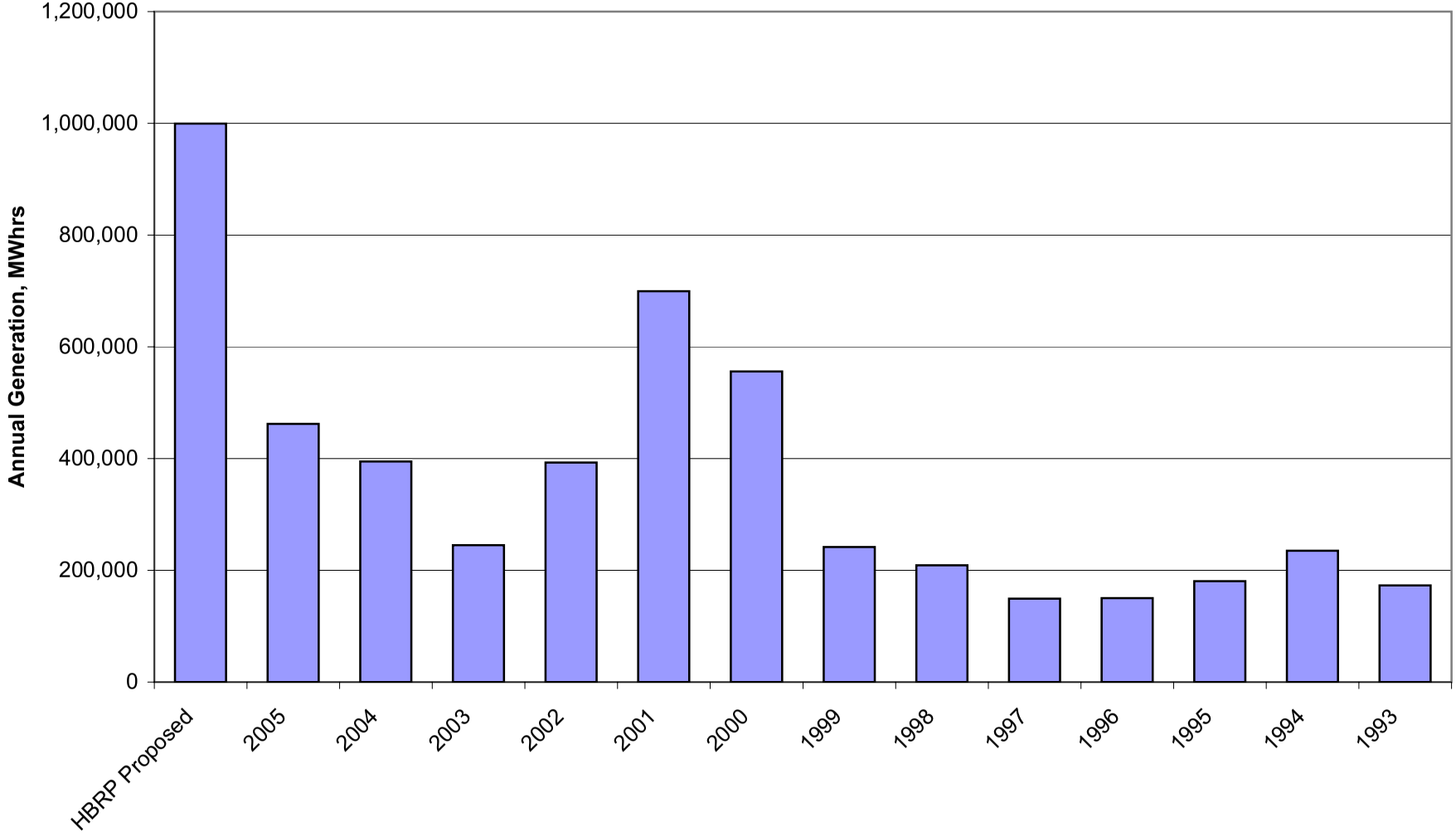
Notes:

[a] Modeled using AERMOD and CTSCREEN; see Table 8.1-21 of the AFC.

[b] Modeled using ISCST3; see Table 8.1D-7 of the AFC. For 1-hour SO_2 and 24-hour average $PM_{2.5}$, combined impacts are dominated by downwash related to the existing MEPPS. Since the existing plant (alone) was modeled using AERMOD, which incorporates advanced techniques related to downwash, and the construction and combined plant impacts analyses were performed using ISCST (which does not include those advanced techniques), the combined impacts appear to be higher than either of the stand-alone values. However, in fact, the worst case impacts for these pollutants and averaging periods would be the higher of the existing plant or construction impacts.

[c] Ozone-limited using ARM and default 0.75 conversion factor.

Figure DR8-1
Comparison of Total Historical Generation at Humboldt Bay Power Plant with Proposed Effective 70% Capacity Factor Limit for Humboldt Bay Repowering Project



Short-term emissions

13. *Please describe the anticipated levels of short-term emissions from operation of the existing HBPP while HBRP commissioning activities take place and prepare a dispersion modeling scenario to evaluate simultaneous operation of the existing power plant with HBRP commissioning. Please provide the air dispersion modeling files in CD format.*

Response: There is no reason to expect that the commissioning activities at HBRP will result in any significant operational or emission changes at the existing Humboldt Bay Power Plant, except for possible decreases in emissions. This is because operation of the existing plant is dictated by the demand for electricity in the region, and the commissioning of the HBRP facility will not significantly affect regional demand. To the extent that power is delivered to the grid by the HBRP units during commissioning, less power generation will be required from the existing plant with a corresponding decrease in emissions.

The requested modeling analysis has been prepared using the same emission rates and operating assumptions used in the AFC for Humboldt Bay Power Plant (see Table 8.1B-2) and for HBRP commissioning activities (see Table 8.1B-10; three separate scenarios were modeled). The maximum-modeled impacts are summarized in Table DR13-1 and the input and output files are provided on the enclosed CD. The combined impacts were modeled using AERMOD and CTSCREEN. Because commissioning will be a short-term activity, no annual average impacts were evaluated.

TABLE DR13-1
Combined Impacts of Humboldt Bay Power Plant Operation and HBRP Commissioning

Pollutant/Averaging Period		Humboldt Bay Power Plant Operation Alone[a] ($\mu g/m^3$)	HBRP Commissioning Alone[b] ($\mu g/m^3$)	Humboldt Bay Power Plant Operation and HBRP Commissioning ($\mu g/m^3$)[c]
NO_2 –	1 hour	267.3	127.0	280.4
CO –	1 hour	110.3	476.0	244.5
	8 hour	55.1	184.8	143.1
$PM_{10}/PM_{2.5}$				
	24 hour	7.8	4.4	8.8

Notes:

[a] From Table 8.1-21 of the AFC.

[b] From Table 8.1D-7 of the AFC. These results were modeled using AERMOD for both simple and complex terrain; the results were not refined using CTSCREEN.

[c] AERMOD (flat terrain) and CTSCREEN (elevated terrain) results. The modeled CO impacts are lower than those presented for commissioning alone because the CTSCREEN model was used to model refined results for the combined activities in elevated terrain. One-hour average NO_2 impacts are calculated from CTSCREEN results using OLM and maximum annual one-hour average ozone readings for the years 2001-2005 from Ukiah.

HBRP commissioning

14. *Please describe whether HBRP commissioning would cause any operational or emission changes at the existing Humboldt Bay Power Plant. Include the scenario of rapid load tests occurring at HBRP, and note whether operation of the existing Humboldt Bay Power Plant while the HBRP is undergoing commissioning would be expected to exceed any of its existing air permit limitations as a result.*

Response: Please see DR13 for a discussion of potential operational or emission changes at the Humboldt Bay Power Plant during HBRP commissioning activities. The Humboldt Bay Power Plant boilers and gas turbines do not have permitted annual emission limits, so operation of the existing power plant while the HBRP is undergoing commissioning would not be expected to cause any exceedances of existing air permit limitations. In fact, as discussed above, commissioning at HBRP could cause reductions in emissions from the existing units.

Maximum impacts

15. *Please demonstrate that maximum impacts on an annual basis have been fully characterized through the worst-case combination of HBPP operation in conjunction with either construction or commissioning of the HBRP over a 12-month period.*

Response: Maximum annual impacts are characterized by the operation of the existing Humboldt Bay Power Plant in conjunction with construction of the HBRP. Impacts during operation of the existing plant in conjunction with commissioning activities at HBRP are expected to be lower on an annual basis because, as discussed above in DR3 and DR14, commissioning will be a short-term activity (the commissioning period is expected to last no more than 180 days; see Note 3 to Table 8.1B-9) and emissions from the existing units may actually be reduced during the commissioning of the new HBRP units.

PM10 24-hour impacts

16. *Please investigate the accuracy of the PM10 24-hour impacts reported in AFC Table 8.1-24 and provide an explanation of how PM10 impacts during diesel firing may be lower than those during natural gas firing, or revise the impact analysis, as necessary to rectify.*

Response: Maximum modeled 24-hour PM_{10} impacts during natural gas firing are higher than maximum-modeled 24-hour PM_{10} impacts during emergency backup liquid fuel firing because the two conditions involve different worst-case engine operating modes. For natural gas firing, worst-case 24-hour average PM_{10} impacts would occur when all 10 engines are operating at 50 percent load for 24 hours. Although this scenario is extremely unlikely to occur, the applicant does not propose to accept a permit condition prohibiting this mode of operation. Because this operating scenario produces the maximum-modeled PM_{10} impacts, these results are presented to provide a complete assessment of reasonably foreseeable impacts.

For emergency backup liquid fuel firing, the applicant has proposed that low-load operation be limited to only 48 engine-hours per day at engine loads below 75 percent. This operating scenario is modeled by assuming that two engines operate for 24 hours at 50 percent load and eight engines operate for 24 hours at 75 percent load. The exhaust parameters used in

modeling this case are shown in Table 8.1B-5 ("24-Hour Averaging Period: PM_{10}, emergency diesel backup operation").

As discussed on p. 8.1-39 of the AFC, each cluster of five Wärtsilä engine stacks was modeled as a single equivalent stack with exhaust temperature and velocity equal to that of the individual stacks. For one of the equivalent stacks, all five engines are operating at 75 percent load, so the velocity for that equivalent stack is equal to that of Case 3D, 31.037 m/s. For the other stack, three of the engines are assumed to operate at 75 percent load (Case 3D) and two of the engines are assumed to operate at 50 percent load (Case 6D). The velocity for the equivalent stack is calculated as follows:

	Individual Stack Parameters				
Stack	Diameter (m)	Velocity (m/s)	Temp (°K)	Flow Rate (m^3/s)	Fraction of Total Flow (percent)
A	1.62	18.223	599.111	37.561	14.066
B	1.62	18.223	599.111	37.561	14.066
C	1.62	31.037	597.444	63.973	23.956
D	1.62	31.037	597.444	63.973	23.956
E	1.62	31.037	597.444	63.973	23.956

As shown on p. 8.1-39 of the AFC, the equivalent stack diameter is calculated as:

$$[(1.62)^2 + (1.62)^2 + (1.62)^2 + (1.62)^2 + (1.62)^2]^{1/2} = 3.62 \text{ meters}$$

The equivalent velocity and temperature are calculated based on the fraction of total flow rate contributed by each individual stack:

Equivalent temperature:

$$(2 * 599.111 * 0.14066) + (3 * 597.444 * 0.23956) = 597.91°K$$

Equivalent velocity:

$$(2 * 18.223 * 0.14066) + (3 * 31.037 * 0.23956) = 27.43 \text{ m/s}$$

The value of 42.4 μg/m^3 in the file NEW2404.OUT is an intermediate AERMOD modeling result for terrain above stack base. As discussed on p. 8.1-38 of the AFC, the CTSCREEN model was used for refined modeling of impacts in complex terrain. The highest CTSCREEN result for terrain above stack base is 13.67 μg/m^3, and is found in the file NewPlant\CTSCREEN\PME24\ SUMREFN2.DAT. The reported maximum-modeled impact of 18.6 μg/m^3 occurs in flat terrain, and is found in the file NewPlant\24hraverage\2004\NEW2404F.OUT.

Trinidad Head ozone data

17. Please describe qualitatively the effects that using Trinidad Head ozone data would have on the results of an OLM analysis compared to the results using the Ukiah data shown in the AFC.

Response: The ozone data at Trinidad Head is collected by NOAA, not by EPA, ARB, or NCUAQMD. To be used for EPA-approved regulatory modeling purposes, the ozone data would have to have been collected in accordance with EPA monitoring guidance and would have to meet EPA criteria for completeness. It is not known whether the Trinidad Head ozone data would meet these requirements, so the Trinidad Head ozone data were not used in the OLM analysis.

Because the OLM calculation assumes that the formation of NO_2 is limited by the ambient ozone concentration, lower ozone concentrations in general would result in lower NO_2 concentrations. Thus, in general, an OLM analysis using the lower ozone concentrations at Trinidad Head should produce lower maximum NO_2 concentrations than the OLM analysis in the AFC, which used generally higher ozone data from Ukiah. [1] However, without comparing individual hourly readings from Trinidad Head and Ukiah, it is not possible to make a definitive determination.

Cumulative sources

18. *Please identify cumulative sources with emissions greater than 10 pounds per day, or provide rationale for a less-stringent de minimis level, and verify that sources within 6 miles have been researched.*

Response: We confirm that there was a typographical error in the AFC suggesting that only sources within 6 km were included in our request to the NCUAQMD for information regarding potential cumulative impact sources. The original request letter to the District did ask for information regarding sources within 6 miles. However, the original request to the District did define *de minimis* sources as those with emissions under 5 tons per year, which was not consistent with the 10 lb / day *de minimis* level shown in the protocol provided in AFC Appendix 8.1F. Copies of our amended request to and the response from the District are attached in Attachment DR18-1. The District's response indicates that there are no sources in the District's files that meet the corrected criteria.

[1] Inland locations, such as Ukiah, typically have higher ozone levels than coastal regions, such as Eureka or Trinidad Head, for reasons related to meteorology and topography.

Attachment DR3-1

Copy of ARB Letter Regarding Applicability of Diesel Compression Ignition ATCM to Wärtsilä 18V50DF Engines

Air Resources Board

Robert F. Sawyer, Ph.D., Chair
1001 I Street • P.O. Box 2815
Sacramento, California 95812 • www.arb.ca.gov

Alan C. Lloyd, Ph.D.
Agency Secretary

Arnold Schwarzenegger
Governor

March 10, 2006

Mr. Kent L. Fickett
Co-CEO and President
Ramco Generating Two, Inc.
61 Avenida De Orinda, Suite 35
Orinda, California 94563

Dear Mr. Fickett:

In response to the request in your letter of February 24, 2006, the Air Resources Board staff conducted a regulatory analysis to determine if your dual-fueled diesel pilot ignition engine technology was subject to the requirements of the Stationary Compression Ignition Engine Airborne Toxic Control Measure (ATCM). Based on our analysis of the data you supplied, we concur that:

1. The requirements in the Stationary Diesel Engine ATCM do not apply to the dual-fuel diesel pilot ignition engines when operating in the natural gas/diesel pilot mode.

2. The requirements in the Stationary Diesel Engine ATCM for Emergency Standby Engines do apply to the dual-fuel diesel pilot ignition engines when operating in the diesel-only mode.

If you have further questions regarding this matter, please contact Mr. Dan Donohoue, Chief of the Emissions Assessment Branch, Stationary Source Division at (916) 322-6023.

Sincerely,

Michael H. Scheible
Deputy Executive Officer

cc: Dan Donohoue, Chief
Emissions Assessment Branch

Ramco Generating Two

61 AVENIDA DE ORINDA, SUITE 35
ORINDA, CA 94563
Tel: (925) 258-9829 Fax: (925) 258-9802

February 24, 2006

Michael Scheible
Deputy Executive Officer
California Air Resources Board
P.O. Box 2815
Sacramento, CA 95812

Dear Mr. Scheible:

We appreciated the opportunity to meet with you on February 2 to present some of the reasons why clean and efficient reciprocating engine technology is a viable solution to the energy needs in some California markets. One such market is the Eureka/Humboldt Bay area. If this technology were selected to replace the existing power plant, it would consist of natural gas engines with Diesel pilot injection. The engines would also have the ability to be fired on 100% Diesel in the event of a natural gas curtailment.

Additionally, the project would comply with the ATCM for Stationary Compression Ignition Engines. In pilot injection mode, the engines operate significantly similar to the theoretical Otto Cycle, and are therefore not "compression ignition engines" as defined in the ATCM. Thus, the ATCM would not apply to the engines while operating in pilot injection mode. In 100% Diesel mode, the engines would be subject to the emission limits, testing and maintenance operational limits, monitoring, and record keeping for "emergency standby engines." This is contingent upon limiting operation in 100% Diesel mode only during periods of natural gas curtailment, in accordance with the definition of "emergency use" in the ATCM.

We are seeking CARB's concurrence with the regulatory analysis of the ATCM summarized above. The replacement of the existing plant with an efficient, true intermediate-load plant will result in substantial reductions in both air emissions and fuel consumption. Thank you again for your time and consideration of this issue.

Sincerely,

Kent L. Fickett
Co-CEO and President
Ramco Generating Two, Inc.

cc: Greg Lamberg, PG&E
Lorraine Paskett, PG&E
Gary Rubenstein, Sierra Research

Attachment DR5-1

December 18, 2006, Operations Forecast for
Humboldt Bay Power Plant

Operating Day				12/18/06										
Mean Eureka Temp Forecast				35										
Expected Gerber Pressure				800										
					Forecast for HBPP							GSO 2006		
		Forecast Load (MW)			Expected Fuel Use				Expected Fuel Use			HBPP Profile		Surplus Gas
					mmBtu/Hr				**Mcf/Hr**			**800#**		
	HE	**#1**	**#2**		**#1**	**#2**		**HE**	**#1**	**#2**		**35**		
	1	6	6		132	132		**1**	130	130		250		-10
	2	6	6		132	132		**2**	130	130		250		-10
	3	6	6		132	132		**3**	130	130		250		-10
	4	6	6		132	132		**4**	130	130		250		-10
	5	6	6		132	132		**5**	130	130		250		-10
	6	10	10		174	174		**6**	171	171		250		-92
	7	52	52		613	613		**7**	601	601		1255		53
	8	52	52		613	613		**8**	601	601		1255		53
	9	40	40		488	488		**9**	478	478		993		37
	10	25	25		331	331		**10**	325	325		642		-8
	11	25	25		331	331		**11**	325	325		642		-8
	12	25	25		331	331		**12**	325	325		642		-8
	13	25	25		331	331		**13**	325	325		642		-8
	14	25	25		331	331		**14**	325	325		642		-8
	15	25	25		331	331		**15**	325	325		642		-8
	16	25	25		331	331		**16**	325	325		642		-8
	17	52	52		613	613		**17**	601	601		1255		53
	18	52	52		613	613		**18**	601	601		1255		53
	19	52	52		613	613		**19**	601	601		1255		53
	20	52	52		613	613		**20**	601	601		1255		53
	21	25	25		331	331		**21**	325	325		642		-8
	22	25	25		331	331		**22**	325	325		642		-8
	23	25	25		331	331		**23**	325	325		642		-8
	24	25	25		331	331		**24**	325	325		642		-8
		667	667		8646	8646			8477	8480		17085		

Attachment DR5-2

December 18, 2006, Hypothetical Operations Forecast
for Humboldt Bay Repowering Project

Operating Day	**12/18/06**
Mean Eureka Temp Forecast	**35**
Expected Gerber Pressure	**800**

	Forecast Load (MW)		**Forecast for HBRP** Expected Fuel Use **mmBtu/Hr**			Expected Fuel Use **Mcf/Hr**		GSO 2006 HBPP Profile **800#** **35**	Surplus Gas
HE	**#1**	**#2**	**#1**	**#2**	**HE**	**#1**	**#2**		
1	6	6	57	57	**1**	56	56	250	138
2	6	6	57	57	**2**	56	56	250	138
3	6	6	57	57	**3**	56	56	250	138
4	6	6	57	57	**4**	56	56	250	138
5	6	6	57	57	**5**	56	56	250	138
6	10	10	96	96	**6**	94	94	250	62
7	52	52	497	497	**7**	487	487	1255	281
8	52	52	497	497	**8**	487	487	1255	281
9	40	40	382	382	**9**	375	375	993	243
10	25	25	239	239	**10**	234	234	642	174
11	25	25	239	239	**11**	234	234	642	174
12	25	25	239	239	**12**	234	234	642	174
13	25	25	239	239	**13**	234	234	642	174
14	25	25	239	239	**14**	234	234	642	174
15	25	25	239	239	**15**	234	234	642	174
16	25	25	239	239	**16**	234	234	642	174
17	52	52	497	497	**17**	487	487	1255	281
18	52	52	497	497	**18**	487	487	1255	281
19	52	52	497	497	**19**	487	487	1255	281
20	52	52	497	497	**20**	487	487	1255	281
21	25	25	239	239	**21**	234	234	642	174
22	25	25	239	239	**22**	234	234	642	174
23	25	25	239	239	**23**	234	234	642	174
24	25	25	239	239	**24**	234	234	642	174
	667	667	6374	6374		6249	6245	17085	

Attachment DR18-1

Correspondence between Sierra Research and NCUAQMD Regarding Emissions Sources to be Included in the Cumulative Impacts Analysis

sierra
research

1801 J Street
Sacramento, CA 95814
Tel: (916) 444-6666
Fax: (916) 444-8373

Ann Arbor, MI
Tel: (734) 761-6666
Fax: (734) 761-6755

December 12, 2006

Simona Altman
Permit Services Division Manager
North Coast Unified Air Quality Management District
2300 Myrtle Ave
Eureka, CA 95501

Re: Cumulative Impacts Analysis
PG&E's Humboldt Bay Repowering Project

Dear Ms. Altman:

In September we wrote to you requesting information that would allow us to prepare an analysis of the cumulative impacts of the proposed Humboldt Bay Repowering Project. This is defined by the CEC as "a cumulative air quality modeling impacts analysis of the project's typical operating mode in combination with other stationary source emissions sources **within a six-mile radius** *which have received construction permits but are not yet operating, or are in the permitting process*." [Emphasis added.] We interpreted this as:

- Projects for which permits to construct have been issued and that began operation after 2005; and
- Projects for which permits to construct have not been issued, but that are reasonably foreseeable.

We indicated in that letter that the CEC staff considers facilities having emissions increases of less than five tons per year to be *de minimis*, so that emissions increases below five tons per year would be excluded from our request. However, we subsequently determined that in the protocol we submitted to the CEC describing our proposed methodology for the cumulative impacts analysis, we indicated that the *de minimis* level would be 10 pounds per day rather than five tons per year.

Your letter of November 9, 2006, indicated that the AQMD had reviewed its records and determined that there were no facilities within a six-mile radius of the proposed project that met the above criteria and had emissions increases greater than five tons per year. We must ask you to determine whether this conclusion also applies when the emissions threshold is 10 pounds per day. As before, emissions of VOCs can be excluded as cumulative impacts of the project on ozone are not modeled but are evaluated on a regional emissions basis.

As before, if there are any facilities that meet these criteria we would like to obtain sufficient emissions information and stack parameters so that we can include these sources in an air quality modeling analysis.

Thank you very much for your assistance. If you have any questions regarding the information we are requesting, feel free to call.

Sincerely,

Nancy Matthews

Nancy Matthews

cc: Brewster Birdsall, Aspen Environmental Group
Greg Lamberg, PG&E
Susan Strachan
Scott Galati
Doug Davy, CH2M Hill
Keith Golden, CEC

NORTH COAST UNIFIED AIR QUALITY MANAGEMENT DISTRICT
2300 Myrtle Avenue, Eureka, CA 95501
Phone: (707) 443-3093 · Fax: (707) 443-3099

December 15, 2006

Nancy Matthews
Sierra Research
1801 J Street
Sacramento, CA 95814

Re: **Cumulative Impacts Analysis**
Humboldt Bay Repowering Project

Dear Ms. Matthews:

This letter is in response to your December 12, 2006 letter, requesting further information for Pacific Gas & Electric Company's Humboldt Bay Repower Project Cumulative Impacts Analysis. Initially, Sierra Research requested emissions data for new sources and sources with emissions increases of over 5 tons per year, within a six-mile radius of the Humboldt Bay Power Plant site.

The Air Quality Management District responded by informing you that there were no new projects on record that met such criteria. Your December 12, 2006 letter further requests information on new emissions sources that have the potential to emit more than 10 pounds of pollutants per day within a 6-mile radius of the site. A review of new projects on file with the AQMD indicates that there are no sources that meet these criteria.

If you have any questions or comments, please do not hesitate to call the Permit Services Division at (707) 443-3093.

Sincerely,

Simona Altman
Permit Services Division Manager
NCUAQMD

Cc: ***Richard L. Martin, Jr.***
Air Pollution Control Officer
NCUAQMD

Roy B. Willis
Plant Manager, HBPP Fossil
Humboldt Bay Power Plant
Pacific Gas and Electric Company
1000 King Salmon Avenue
Eureka, CA 95503

John Kessler, Project Manager
California Energy Commission
1516 Ninth Street, MS-15
Sacramento, CA 95814-5112

Michael Tollstrup, Chief
Project Assessment Branch
Stationary Source Division
California Air Resources Board
1001 I Street, 6th Floor
Sacramento, CA 95814

Biology

Data Response 19

Biology (19)

Agency consultation

19. Please provide an update on any consultation with USFWS regarding biological resources and the HBRP. Also, please provide copies of any relevant correspondence with USFWS regarding the HBRP.

Response: Project Biologist, Debra Crowe, has been in contact with Greg Goldsmith of the U.S. Fish and Wildlife Service (USFWS) in Arcata. Mr. Goldsmith has stated that he does not believe there are any threatened or endangered species that will be affected by the HBRP project (see record of conversation attached as Attachment DR19-1).

PG&E is in the process of completing the Biological Assessment for the project, which concludes that the project will not impact any listed species. This document will be submitted with a 404 permit application to the U.S. Army Corp of Engineers (USACE) after the wetland delineation verification site visit expected in February 2007. The USACE will forward the Biological Assessment to the USFWS asking for their concurrence with the conclusions of the Biological Assessment.

Attachment DR19-1

Telephone Conservation Record, June 21, 2006

CH2MHILL TELEPHONE CONVERSATION RECORD

Call To: Greg Goldsmith/USFWS Arcata

Phone No.: (707) 825-5120 **Date:** June 21, 2006

Call From: Debra Crowe/CH2MHILL **Time:**

Message Taken By: CH2M HILL

Subject: Humboldt Bay Repowering Project consultation requirements

Project No.: **344005**

I called Greg Golsmith/fisheries biologist with U.S. Fish and Wildlife Service (USFWS) Arcata at the request of his Field Supervisor/Mike Long to discuss the potential for any impacts to federally threatened or endangerd species in the area of Buhne Point on the Humboldt Bay. We discussed the list of species that are represented on the USFWS web site for Arcata South, Eureka, and Fields Landing USGS quadrangles. Greg indicated the tidewater goby would only be of concern if the HBRP would use water from the intake channel that comes off the Humboldt Bay. He mentioned that the Fish and Wildlife Coordination Act may be tied to the wetland loss at the site. The USACE would request concurrence with the Act from USFWS along with the biological assessment. Greg was to check around with other biologists in the Arcata office to see if there were any concerns or issues the project could have on any other species or sensitive areas, in particular the Humboldt Bay National Wildlife Refuge 5 miles south of the site.

Greg Goldsmith called me back on June 22 and indicated there were no concerns from other biologists with take of listed species at the site. I did tell him the Northern red-legged frog was observed and that we would be addressing species of special concern under the California Energy Comission process (primarily protecting the frog during construction with biological monitoring and relocating frogs to areas outside the construction fence). He did mention that interrelated-interdependant issues could come up, such as placing new access roads over special-status species habitats (should be none). Greg said we should not have to conduct formal consultation, and that it would be possible for informal consultation with a concurrence letter to the USACE (as lead federal agency for consultation under Section 7 of the Endangered Species Act).

Cultural Resources

Data Responses 20-27

Cultural Resources (20-27)

County list of historic resources

20. Please provide copies of listings of properties within ½ mile of the project site that have been designated as cultural or historic resources according to a local ordinance by Humboldt County that establishes a listing of historic resources.

Response: Mr. Andrew Bundschuh of the Humboldt County Public Works Department, Natural Resources Division, responded on Thursday, December 14, 2006 with information that there are two known cultural or historic sites within one half-mile of the HBRP site; both of them ethnographic village sites of the Wiyot Tribe. Neither of these sites is within the HBRP Area of Potential Effects.

According to Beth Burks, Planner with the Humboldt County Community Development Service Department, Planning Division, Humboldt County maintains a list of historic buildings titled "County Historic Structure Designations." There are currently three properties on this list, located in Garberville, Port Kenyon, and Table Bluff. None of these are located within one half-mile of the HBRP site.

Historic building and structure listing requirements

21. Please provide a copy of the requirements used by Humboldt County to qualify buildings or structures for the listing.

Response: Ms. Burks is not aware of specific criteria for listing on the County Historic Structure Designations list. Listing requires a resolution of the Board of Supervisors.

Native American consultation

22. Please make one telephone call to Native American individuals or groups listed by the NAHC who have not responded to ensure that they have received the correspondence and to verify that they do not have any information regarding cultural resources in the project area. Please provide documentation for each call, and note any comments regarding the project area provided by the Native Americans.

Response: The Native American Heritage Commission (NAHC) provided a list of 11 individuals who may be interested in consulting with project proponents regarding cultural resource issues in Humboldt County. Each of these persons belongs to one of three tribal organizations: The Bear River Band of Rohnerville Rancheria, the Blue Lake Rancheria, and the Wiyot Tribe. The Applicant sent letters to every person named on the NAHC list and for each person belonging to a given tribe, the address was the same. All three of the Native American tribal groups listed by the NAHC responded to letters sent to them, and follow-up telephone calls were made to the tribal official who contacted the Applicant on behalf of a particular tribe. Appendix 8.3E of the AFC contains the list received from the NAHC, copies of the letters regarding the HBRP, copies of the letters received, and Records of Conversation of the telephone calls.

Additional Native American responses

23. *Please provide copies of any additional written responses received from Native Americans since the AFC was compiled. If responses have been received by telephone, please provide a summary of each conversation. If the location of archaeological sites may be revealed in the information, please provide the responses under confidential cover.*

Response: There have been no additional written or telephone responses from Native Americans received since the AFC was compiled.

Soil borings

24. *If any additional geotechnical borings are performed in conjunction with preparing the final Geotechnical Investigation Report for this project within the coming nine months, please have the borings examined by an archaeologist on site and provide a discussion of the findings to the Energy Commission staff.*

Response: There may be additional geotechnical borings conducted in conjunction with the preparation of the final Geotechnical Investigation report. These borings will be few in number, and will mostly be shallow investigations conducted in areas of fill that were placed on the HBRP site during construction of Units 1, 2, and 3. Section 25105 of the Warren-Alquist Act excludes "soil or geologic investigation" from the definition of construction. Therefore, PG&E does not believe it is appropriate to require Cultural Resources monitoring for the additional geotechnical borings that may be needed. However, PG&E will instruct the geotechnical drilling crews to carefully observe the boring cores for artifacts or anthropogenic soils (such as shell middens), and to collect any such artifacts or soils samples for examination by a qualified archaeologist.

Native soil intrusion

25. *Please provide a discussion that identifies the probable locations of intrusion into native soil caused by either excavation or fill removal and replacement.*

Response: Existing sources indicate that the Humboldt Bay Power Plant site was leveled at the time of construction of Units 1, 2, and 3. Much of the material removed from the northern part of the site was deposited as fill in the formerly marshy area immediately north of Buhne Slough. Much of the HBRP site, therefore, is located on 2 to 8 feet of fill from these excavations. For this reason, excavations for piping, duct banks, foundations, and other purposes for the HBRP is most likely to encounter native soil where the fill is shallowest, at the northern margins of the HBRP site. Excavations for the project that will be located to the south, closer to Buhne Slough are less likely to extend through the fill to native soil deposits.

Borrow and disposal sites

26. *If removed soils will be disposed of off-site and/or new soils brought in, and if disposal and borrow sites are not commercial operations and consequently have not been surveyed for cultural resources, please conduct such surveys and provide the personnel qualifications, methods, and findings to staff.*

Response: At this time, PG&E has not designated a specific borrow area as a source of fill. Any fill needed will be purchased from commercial enterprises. Any potential supplier of

fill would be independently responsible for compliance with local, state, and federal laws associated with generating fill material. However, should PG&E elect to generate its own fill material from a new borrow site, archaeological surveys of non-commercial borrow sites would be conducted at that time by qualified persons and the information provided to Staff.

DPR 523 District forms

27. Please have a qualified architectural historian or a historian who specializes in industrial history (meeting the Secretary of Interior standards) update the extant DPR 523 District forms to effectively support the contention that the power plant buildings and facilities constitute a District, and identify and justify the contributing elements. If a District cannot be justified, please have the qualified architectural historian record the properties separately on DPR 523s "Primary" and "Building, Structure, and Object" forms and provide copies of the forms.

Response: The AFC reviewed the previous work done to document the historical significance of Humboldt Bay Power Plant Unit 3, and considered the HBRP's potential effects on Unit 3 and also on other potentially significant properties adjacent to or near the HBRP, such as Units 1 and 2. The potential effects of the HBRP would be direct effects related to the demolition of a storage building, a 115 kV transmission tower, and a portion of a railroad spur leading to the HBRP. The potential effects on Units 1, 2, and 3 would be indirect, visual effects. None of the structures or buildings within the area of direct impacts of the HBRP were found to be individually significant. These properties were also considered in the context of a potentially significant National Register historic district, because Units 1, 2, and 3 and their appurtenant facilities were all constructed in the same general time frame, by the same entity, and for the purpose of providing a reliable power supply for Humboldt County.

This data request response considers the National Register eligibility of the collection of properties, considered as a district. Attachment DR27-1 consists of a technical memorandum, prepared by a qualified architectural historian, and which evaluates the National Register eligibility of the entire Humboldt Bay Power Plant (including Units 1, 2, and 3, and appurtenant facilities) considered as a district. The memorandum is based on additional fieldwork conducted in October 2006 to supplement the information provided in the AFC. Accompanying the memorandum is an updated form DPR-523d, the District Record form that lists the individual buildings and structures that date to the period of construction on the Humboldt Bay Power Plant site in a tabular form. The Continuation Sheets also contain photographs of most of these buildings and structures.

This District Form supplements the DPR-523a Primary Record and DPR-523b Building, Structure, and Object Records (BSOR) for Storage Building, 115 kV transmission tower, and railroad spur that were provided in the AFC. This submittal does not include BSOR forms for all of the individual properties within the potential district's boundary, because (1) the properties making up the potential district do not qualify for listing on the National Register, either individually or as a district, (2) the HBRP will not affect these properties, and (3) the properties are too numerous (approximately 60 buildings and structures) to document, given that the district considered does not meet the criteria for National Register listing.

Attachment DR27-1

Humboldt Bay Power Plant District Evaluation

Humboldt Bay Power Plant District Evaluation

TO: Doug Davy, Project Manager

FROM: Jessica Feldman, Architectural Historian

DATE: December 21, 2006

Introduction

This memorandum evaluates whether or not the buildings and structures located at Pacific Gas and Electric Company's (PG&E's) Humboldt Bay Power Plant are (1) sufficiently similar in their purpose and history that they constitute a district of properties, for the purposes of evaluating their eligibility for nomination to the National Register of Historic Places and (2) whether or not these properties, individually or collectively, meet the criteria for National Register listing. PG&E has previously conducted studies that support the National Register eligibility of Humboldt Bay Power Plant Unit 3 under Criterion Consideration G for properties younger than 50 years. PG&E Units 1 and 2 and their appurtenant facilities, including the facilities that Units 1 and 2 share with Unit 3, however, have not been formally considered for National Register nomination as a district and in accordance with the National Park Service criteria for the evaluation of properties as districts.

The Application for Certification for the Humboldt Bay Repowering Project (HBRP) considered the HBRP's potential effects on Unit 3 and also on other potentially significant properties adjacent to or near the HBRP, such as Units 1 and 2. The potential effects of the HBRP would be direct effects related to the demolition of a storage building, a 115 kV transmission tower, and a portion of a railroad spur leading to the HBRP. The potential effects of the HBRP on Units 1, 2, and 3, however, would be indirect, visual effects. None of the structures or buildings within the area of direct impacts of the HBRP was found to be individually significant.

These properties were also considered in the context of a potentially significant National Register historic district, because Units 1, 2, and 3 and their appurtenant facilities were all constructed in the same general time frame, by the same entity, and for the purpose of providing a reliable power supply for Humboldt County. The AFC included a DPR 523a Primary Form for the Humboldt Bay Power Plant, a DPR 523d District Record form, and DPR 523b Building, Structure, and Object Record (BSOR) forms for the three properties (storage building, 115 kV transmission tower, and railroad spur) that would be removed as part of HBRP construction. The AFC concluded that Units 1 or 2 and appurtenant facilities would be unlikely to be eligible for National Register listing but that, in any case, the HBRP project's effects, of (1) removing these three structures and (2) introducing a new visual element, would not be consequential even if the properties were to be considered to have historical significance. This memorandum supplements the AFC and provides a more detailed analysis of the Humboldt Bay Power Plant as a district of related properties in terms the criteria for National Register listing for districts. It presents the results of additional fieldwork, conducted by Jessica Feldman in October 2006.

Location

The Humboldt Bay Power Plant is situated on 143 acres approximately 3 miles south of the City of Eureka, Humboldt County, California. The property occupies most of the inhabitable area of Buhne Point, except for the small community of King Salmon, which is located just to the south of the site. All of the Humboldt Bay Power Plant property is northwest of the Northwestern Pacific Railroad alignment, and the northern boundary of the Humboldt Bay Power Plant is marked by the main shipping channel for Humboldt Bay. An arm of the property dips southwest towards the Fields Landing navigation channel.

History

The Humboldt Bay Power Plant[2] is a large energy-related industrial complex, complete with two natural gas-fired steam generating plants (Units 1 and 2), one currently inoperable nuclear reactor (Unit 3) that is in the decommissioning process, and many related support structures and equipment. It has been an active power plant since 1956, when Unit 1 was constructed; Unit 2 was in place in 1958. Site plans from this era show that the construction of future units was planned, with possibly two more units to complete the expansion. Instead of continuing with a fossil fuel-burning unit, however, PG&E instead constructed a boiling-water nuclear reactor in 1963, which ceased operation in 1976.

The first steam-generated electricity in Eureka came in the early 1880s, after the success of nearby lumber mills, which used steam-powered generators to produce electricity for their arc lamps. In 1886, the Eureka Electric Light Company (EELC) formed and, within several years, the Eureka Gas Company, which had been established in the late 1870s, was merged with the EELC to form the city's Eureka Lighting Company. PG&E acquired the system that was descended from EELC, known as the Western States Gas and Electric Company, in 1910. However, the power produced by the sole steam generating plant and transmission system was not enough to keep up with the post-World War II needs of the booming construction industry.

In the early 1950s, when PG&E began planning the construction of a power plant that would serve the increasing demand for power in the region; they chose a location south of Eureka known as Fields Landing. This plant would connect, via transmission lines through the Sacramento Valley, to the California power grid. Completed in 1958, the Humboldt Bay Power Plant consisted of two fossil-fuel plants (Units 1 and 2), associated oil storage and service tanks, a 60kV switchyard, a warehouse, fire pump house, office, shop, yard relay building, and intake / discharge facilities. In total, each unit was capable of producing 25 MW of power. PG&E knew that this would not be enough energy to meet needs of the region; it was anticipated that by 1960 the demand would grow to 115 MW. With this expected increased demand, PG&E began planning for Unit 3, which would be a nuclear reactor capable of producing 52 MW.

The Humboldt Bay Power Plant is one of 34 steam turbine power plants operating in California. There is no evidence that the Humboldt Bay Power Plant represents a significant

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[2] The discussion of the history of the Humboldt Bay Power Plant is abridged; it is discussed in further detail in "Cultural Resources Study For The PG&E Humboldt Bay Power Plant, ISFSI Licensing Project," prepared by PAR Environmental Services, Inc. for Pacific Gas and Electric, Revision I, August 2003 (PAR:2003). See also the February 24, 2006 Memorandum from JRP Historical Consulting to CH2M HILL regarding Cultural Resource Compliance of the South Bay Power Plant in Chula Vista, San Diego County, California (JRP:2006).

development in the power generation capacity of PG&E. The period between 1950 and 1970 was, "the peak expansion of steam generating capacity for the Southern California Edison and PG&E, as well as for smaller utility companies (JRP 2006)." Furthermore, PG&E was already operating fifteen steam electric plants in California three years before the planning and construction of the Humboldt Bay Power Plant (JRP 2006). A plant constructed at Pittsburg in 1959-60 was considered the largest steam station in the west (JRP 2006).

Previous Studies

A records search revealed one previously conducted study of the Humboldt Bay Power Plant, prepared for PG&E in 2003 when the utility company was looking at possible locations for an Independent Spent Fuel Storage Installation (ISFSI) dry cask storage area. The 2003 report by PAR Environmental Services, Inc. (PAR) determined that Unit 3 is individually eligible for the NRHP under Criterion Consideration G.

Unit 3 appears exceptionally significant (Criterion Consideration G) in the history of the commercial nuclear power industry and appears to meet Criteria A and C of the NRHP at a national level (PAR, 2003). Unit 3 has had few modifications since it went on line in 1963 and retains integrity of location, setting, design, workmanship, feeling, and association. Its period of significance begins in 1961, when the unusual construction methods and design elements used in the pressure suppression chamber were devised, until 1984 when Unit 3 was placed in the Nuclear Regulatory Commissions program for safe storage for a nuclear facility (retirement), termed SAFSTOR.

Under Criterion A of the NRHP, PAR found Unit 3 to be important for its association with the development of nuclear power on a national level. The Humboldt Bay Power Plant was the seventh nuclear power plant constructed in the United States, but was the first to be constructed as an economically viable, commercial reactor. Under Criterion C, PAR determined that certain elements of the unit, such as the pressure suppression chamber and the spent fuel pool, are key factors of the unit's individual importance, because of their innovative construction and design, while other equipment (e.g., the control room, turbine, reactor) are contributing features of overall plant design (PAR, 2003). According to the PAR report, the period of significance for Unit 3 under Criterion A is 1961-1984, which encompasses the dates for construction of Unit 3 through the completion of the spent fuel pool and SAFSTOR-regulation storage of the fuel. Under Criterion C, the period of significance for Unit 3 was limited solely to 1963, the year the power plant went online.

The field survey team for the AFC surveyed the lands immediately adjacent to and east of the current power plant facility where the proposed Humboldt Bay HBRP would be located, the access road on the south side of the Intake Canal, and the proposed construction staging and parking areas. This survey also established that there were no buildings or structures over 50 years of age that met the NRHP criteria in these specific areas.

The AFC concludes:

In terms of the four National Register Criteria, the Units do not appear to be associated in a significant way with broad patterns of our history (Criterion A). Although Units 1 and 2 are associated with the advancement and development of electric power production in Humboldt County and California, this association is not singular or of exceptional historical

importance. Units 1 and 2 are two among many similar steam-electric plants built during this time period in the California to serve a similar purpose.

Units 1 and 2 do not appear to be associated with the life of a historically significant person or persons (Criterion B). They also do not embody the distinctive characteristics of a type, period, or method of construction (Criterion C). Units 1 and 2 are of standard design and engineering and, as utilitarian structures; do not embody significant stylistic features. Their design is the standard "semi-outdoor" type, with the open steel boiler framework and roofing and cladding in the upper stories and the remainder exposed. These units do not appear to have any exceptional characteristics. They are not exceptionally large or small, do not appear to encompass any original or innovative design characteristics, or engineering or construction techniques. Similarly, Units 1 and 2 do not appear to have the ability to provide information important in history. Units 1 and 2 are not historic properties in terms of either the National Register or California Register of Historical Resources.

The AFC described the Humboldt Bay Power Plant as consisting of two fossil-fired steam turbine units (Units 1 and 2), Unit 3, administration buildings, shops, storage buildings, large fuel tanks, a railroad spur, an electrical substation, several 60kV transmission lines, one 115kV transmission lines, and a cooling water intake and discharge channel. The boundary of a potential historic district coincides with the PG&E "Owner-Controlled Area," approximately seventy acres of the total site, and within the fenced-in area.

National Register Evaluation

The NRHP provides guidance on the definition of historic properties and districts.

Definition: *A district possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development.*

According to this definition, the Humboldt Bay Power Plant could be established as a district. Within approximately seventy acres, the Humboldt Bay Power Plant contains a significant concentration of structures all associated with the production of energy for the Humboldt County Region of northern California and these structures are linked by a plan by PG&E that began in 1956 and concluded in 1963 for this sole purpose.

Concentration, Linkage, & Continuity of Features: *A district derives its importance from being a unified entity, even though it is often composed of a wide variety of resources. The identity of a district results from the interrelationship of its resources, which can convey a visual sense of the overall historic environment or be an arrangement of historically or functionally related properties.*

The Humboldt Bay Power Plant does meet this definition, as all of the buildings and structures convey both the visual and physical feeling of an operating power plant (despite the fact that Unit 3 is not currently operable).

Types of Features: *A district can comprise both features that lack individual distinction and individually distinctive features that serve as focal points. It may even be considered eligible if all of the components lack individual distinction, provided that the grouping achieves significance as a whole within its historic context. In either case, the majority of the components that add to the district's historic character, even if they are individually undistinguished, must possess integrity, as must the district as a whole.*

Because it will be established that the Humboldt Bay Power Plant does not meet the criteria for listing as a National Register historic district, there is no need to discuss the types of features as part of a general description of the potential district. Additionally, there is no need to establish the integrity of the individual buildings at the site nor to evaluate the integrity of the site as whole since the Humboldt Bay Power Plant is not eligible for listing as a historic district (see discussion below under Significance).

Geographical Boundaries: *A district must be a definable geographic area that can be distinguished from surrounding properties by changes such as density, scale, type, age, style of sites, buildings, structures, and objects, or by documented differences in patterns of historic development or associations. The boundaries must be based upon a shared relationship among the properties constituting the district.*

The boundaries of a potential Humboldt Bay Power Plant district would include the entire built environment within the fenced-in area, totaling less than half the entire acreage of the Humboldt Bay Power Plant. This was the area surveyed in October 2006.

Significance: *A district must be significant, as well as being an identifiable entity. It must be important for historical, architectural, archeological, engineering, or cultural values. Therefore, districts that are significant will usually meet the last portion of Criterion C, plus Criterion A, Criterion B, other portions of Criterion C, or Criterion D.*

To establish significance, it is important to establish a period of significance. There is evidence that this should include the three construction phases (1956, 1958 and 1963), which would require that the district as a whole be evaluated under NRHP Criteria Consideration G. If the period of significance spanned 1956-1963, it would have to be evaluated under *Criteria Consideration G: Properties That Have Achieved Significance Within The Last Fifty Years.* According to the NRHP guidelines for this criterion, properties whose construction began more than fifty years ago, but whose completion overlaps the fifty-year period by a few years or less, **or** a district in which a few properties are newer than fifty years of age, but the majority of the properties and the most important period of significance are greater than fifty years old, would not meet Criteria Consideration G. The Humboldt Bay Power Plant, therefore, does not meet this criterion.

Conversely, the period of significance for the Humboldt Bay Power Plant could be established as 1956-1958, the period of construction for Units 1 and 2, which continue to operate as power plants. Although Unit 2 is not yet fifty years of age, it will be when construction of the HBRP is completed. Please see the attached form DPR 523 for a list of those buildings that are associated with each construction phase (Appendix A to this memorandum). If the basis for the significance of the district is 1956-1958, then the district needs to meet *Criterion C: Design/Construction*, especially that part which reads: "a property that represents a significant and distinguishable entity whose components lack individual distinction."

In evaluating Humboldt Bay Power Plant against Criterion C, the Humboldt Bay Power Plant, as a whole, does not embody the distinctive characteristics of a type, period, or method of construction, it does not represent the work of a master, nor does it possess high artistic value. According to both a general history of steam-power plants in California and a specific history of the Humboldt Bay Power Plant, it seems likely that it was designed similarly in both plan and construction to pre-existing and later power plants in the state, as

well as those owned by PG&E. Steam turbine technology, initially developed as an offshoot of the conventional steam engine in the late 1800s, continued to develop and improve through the 1950s. PG&E and other California utilities began building steam-electric plants during the 1920s and 1930s and continued doing so through the 1960s. After World War II, steam plants gained popularity in comparison with hydroelectric plants.

These steam plants were built near load centers, near a water supply, and near fuel supplies and mostly, but not entirely, in coastal locations. Units 1 and 2 and the associated structures built between 1956 and 1958, such as fuel storage and service tanks, the switchyard and the distilled water tanks, were all built according to common designs, and meet the general parameters for site location. As has been noted previously in this document, according to the California Energy Commission, there are currently 34 steam turbine power plants in California. Based on these conclusions, the Humboldt Bay Power Plant does not meet the remaining requirements of Criterion C.

There is no evidence that suggests the Humboldt Bay Power Plant meets *Criterion A: Events*, as there are no known events that made a significant contribution to the broad patterns of our history associated with this property, or with the individual elements that comprise the site. Furthermore, when applying *Criterion B: Associated With Lives of Significant People*, there is no evidence that the Humboldt Bay Power Plant, or its individual components, is associated with the lives of persons significant in our past.

Humboldt Bay Power Plant Units 1 and 2 are not singular or of exceptional historical importance. They do not meet the National Register criteria for either A (events), B (people), C (design and construction), or D (history). These properties, furthermore, do not form a significant historic district in conjunction with each other or with Unit 3. Unit 3 meets the criteria for exceptional significance under Criterion Consideration G as an individual property. This significance stems entirely, however, from its place in the history of nuclear power development in the United States and not from its role in supplying electricity to Humboldt County.

Conclusion

Based on the preparation of a historic context, establishment of building dates and associated construction phases, the National Register of Historic Places guidelines for establishing the significance for historic district, and the application of the National Register Criterion for Evaluation, the Humboldt Bay Power Plant is not eligible for the National Register of Historic Places as a historic district.

References

PAR Environmental Services. 2003. Cultural Resources Study For The PG&E Humboldt Bay Power Plant, ISFSI Licensing Project. prepared by PAR Environmental Services, Inc. for Pacific Gas and Electric, Revision I, August 2003.

JRP Historical Consulting. 2006. February 24, 2006 Memorandum from JRP Historical Consulting to CH2M HILL regarding Cultural Resource Compliance of the South Bay Power Plant in Chula Vista, San Diego County, California.

Appendix A

Forms DPR-523

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code _____
Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #:** (Assigned by recorder) PL-1

P1. Other Identifier: PG&E Humboldt Bay Power Plant

***P2. Location:** ☒ **Not for Publication** ☐ **Unrestricted** ***a. County** Humboldt

***b. USGS 7.5' Quad** Fields Landing **Date** 1959 revised 1972 T4N; R1W; SW ¼ o f Sec 8; M.D.B.M

c. Address 1000 King Salmon Avenue City Eureka, CA Zip n/a

d. UTM: Zone 10, Point A = 397895 m E & 4510915 m N; Point B = 397995 m E & 4510740 m N; Point C = 397660 m E & 4510550 m N; Point D = 397560 m E & 4510730 m N.

e. Other Locational Data: From the intersection of Highway 101 and King Salmon Ave., approximately 5 miles south of Eureka, Humboldt Bay Power Plant is to the east of King Salmon Ave. along the north side of the slough channel.

***P3a. Description:** This site consists of the PG&E Humboldt Bay Power Plant. The facility is comprised of two fossil fuel units (Units 1 & 2) which were completed in 1956 and 1958, and a small General Electric boiling water nuclear reactor which came into service in 1963 (Unit 3). Unit 3 was shut down in 1976 for routine refueling and seismic retrofit work. After the Three Mile Island nuclear accident in 1979 new standards were initiated by the Nuclear Regulatory Commission which required compliance prior to licensing. PG&E decided that the costs associated with the seismic retrofit and the new licensing standards made the unit unfeasible so it started the decommissioning process of the nuclear facility in 1983. Several other support buildings and structures are associated with the facility and its three power generation units including fuel oil storage tanks, a 60 kv switchyards, a water intake canal, a discharge canal, effluent and acid storage ponds, storage buildings, offices, railroad spur, a guard house and security buildings.

***P3b. Resource Attributes:** HP9 Public Utility Buildings & Facilitiies

***P4. Resources Present:** ☒Building ☒Structure ☐Object ☐Site ☒ District ☐Element of District ☐Other (Isolates, etc.)

P5b. Description of Photo: Overview NW of Units 1, 2 & 3 at the PG&E Humboldt Bay Power Plant, view west

***P6. Date Constructed/Age and Source:** 1956 to present
☒Historic
☐Prehistoric ☐ Both

***P7. Owner and Address:** PG&E, 1000 King Salmon Way, Humboldt County, CA.

***P8. Recorded by:** Will Shapiro; Pacific Legacy, Inc., 3081 Alhambra Dr. Suite 208, Cameron Park, CA 95682

***P9. Date Recorded:** 4-10-06

***P10. Survey Type:** Phase I Inventory

***P11. Report Citation**: Application for Certification for the PG&E Humboldt Bay Repowering Project. Prepared by CH2MHill for PG&E (2006)

***Attachments:** ☐NONE ☒ Location Map ☐ Sketch Map ☐ Continuation Sheet ☒ Building, Structure, and Object Record ☐Archaeological Record ☒ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (List): _____

*NRHP Status Code:

*Resource Name or # (Assigned by recorder): Humboldt Bay Power Plant

D1. Historic Name: Humboldt Bay Power Plant

D2. Common Name: Humboldt Bay Power Plant

***D3. Detailed Description** (Discuss overall coherence of the district, its setting, visual characteristics, and minor features. List all elements of district.):

The Humboldt Bay Power Plant is a power generation facility consisting of two fossil-fired steam turbine units (Units 1 and 2) and a currently inoperable nuclear boiling water reactor steam turbine unit (Unit 3), located on a 143-acre site near Eureka, California. Support facilities include administration buildings, shops, storage buildings, large fuel tanks, a railroad spur, an electrical substation, several 60 kV transmission lines, one 115 kV transmission line, and cooling water intake and discharge channels. Portions of the property outside of the fenced "owner-controlled area" are undeveloped natural areas or wetlands.

***D4. Boundary Description** (Describe limits of district and attach map showing boundary and district elements.):

The district boundary is the same as the PG&E "Owner-Controlled Area." This is the fenced in area that contains the power plant and appurtentnant facilities. This area is approximately 70 acres.

***D5. Boundary Justification:**

The district boundary contains all of the elements of the power plant that contribute to its use as a power generation facility.

***D6. Significance: Theme:** Nuclear power, thermal power development **Area:** 70 acres

Period of Significance: 1963-1984 **Applicable Criteria:** A, C
(Discuss district's importance in terms of its historical context as defined by theme, period of significance, and geographic scope. Also address the integrity of the district as a whole.)

The Cultural Resources Study for the PG&E Humboldt Bay Power Plant ISFSI Licensing Project (PAR 2003), makes the case that Unit 3 (the nuclear unit) of the Humboldt Bay Power Plant meets the critieria for for listing in the National Register as an exceptionally significant property (less than 50 years old) because of its status as one of the first nuclear power plants constructed in the United States, the fact that it was the first nuclear plant proposed that clearly demonstrated economic feasibility/superiority over alternatives possible in this region, and because of its revolutionary design and construction methods. This raises the question as to whether or not the Humboldt Bay Power Plant with all of its components (Units 1, 2, and 3) would qualify for National Register listing as a district of related properties, or whether Units 1 and 2 would qualify for listing as individual properties or as a district in their own right. As stated on Page 1, the of two fossil fuel units, Units 1 & 2, were completed in 1956 and 1958, respectively, Unit 3, the nuclear boiling water reactor, came into service in 1963. To qualify as a National Register Historic District, it would be necessary for these properties to form an identifiable district possessing "a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development." While these buildings are linked historically by plan and physical development in that they were all constructed in the same general time frame, by the same entity, and for the purpose of providing a reliable power supply for Humboldt County, this collection of properties does not achieve significance as a district. (Continued)

D7. References (Give full citations including the names and addresses of any informants, where possible.):

Pacific Gas & Electric Company. 2003. Environmental Report, Independent Spent Fuel Storage Installation. Submitted to the Nuclear Regulatory Commission. Prepared by PG&E, San Francisco.

PAR Environmental Services. 2003. Cultural Resources Study for the PG&E Humboldt Bay Power Plant ISFSI Licensing Project. Submitted to the Nuclear Regulatory Commission. Prepared by PG&E, San Francisco. Prepared by PAR Environmental Services, Sacramento, CA.

***D8. Evaluator:** Jessica B. Feldman **Date:** October 12, 2006
Affiliation and Address: CH2M HILL, New Orleans, Louisiana

D6. Significance (continued from page 2, District Record)

In evaluating HBPP against Criterion C, the HBPP, as a whole, does not embody the distinctive characteristics of a type, period, or method of construction, it does not represent the work of a master, nor does it possess high artistic value. According to both a general history of steam-power plants in California and a specific history of the HBPP, it seems likely that it was designed similarly in both plan and construction to pre-existing and later power plants in the state, as well as those owned by PG&E. Steam turbine technology, initially developed as an offshoot of the conventional steam engine in the late 1800s, continued to develop and improve through the 1950s. PG&E and other California utilities began building steam-electric plants during the 1920s and 1930s and continued doing so through the 1960s. After World War II, steam plants gained popularity in comparison with hydroelectric plants.

These steam plants were built near load centers, near a water supply, and near fuel supplies and mostly, but not entirely, in coastal locations. Units 1 and 2 and the associated structures built between 1956 and 1958, such as fuel storage and service tanks, the switchyard and the distilled water tanks, were all built according to common designs, and meet the general parameters for site location. As has been noted previously in this document, according to the California Energy Commission, there are currently thirty-four steam turbine power plants in California. Based on these conclusions, the HBPP does not meet the remaining requirements of Criterion C.

There is no evidence that suggests the HBPP meets *Criterion A: Events*, as there are no known events that made a significant contribution to the broad patterns of our history associated with this property, or with the individual elements that comprise the site. Furthermore, when applying *Criterion B: Associated With Lives of Significant People,* there is no evidence that the HBPP, or its individual components, is associated with the lives of person significant in our past.

Units 1 and 2 are not singular or of exceptional historical importance. They do not meet the National Register criteria for either A (events), B (people), C (design and construction), or D (history).

Name	Year Built	Year Removed	Year Altered	Type of Alteration
Unit 1	1954		Various	Office, shops and warehouse expansion (19
Unit 2	1958		Various	Not significantly altered
Unit 3	1963		1988	Decommissioned; stack removed
Relay Building	1954		1958	Expansion which double its size.
Well No. 1	Unknown	Doesn't appear on site plans after 1954		Closed in; non -operational
C.W. Intake Structure	1954		1958 (Unit 2), 1963 (Unit 3)	Additions for each new unit. No other known significant alterations
Intake Canal	1954		1963	North end widened/ dredged (?)
Discharge Canal	1954		Unknown	No known alterations
Discharge Headworks	1954		Unknown	No known alterations
Discharge Canal Outlet	1954		Unknown	Possible dredging and/ or widening; no significant alterations.
Oil-Water Separator (aka Oily Water Separator)	1954			No known alterations
Distilled Water Tanks (2)	1954			No known alterations
Fresh Water Tank (aka Raw Water Tank)	1954			No known alterations
Propane Tank	1954			No known alterations
CO2 Tank	1954			No known alterations
Fire Pump House	1954			No known alterations
Fuel Oil Tank 1 (aka No. 1 Fuel Oil Storage Tank)	1954		No	No known alterations
Fuel Oil Tank 2 (aka No. 2 Fuel Oil Storage Tank)	1958			No known alterations
Entrance Road	1954		1958	Extended to reach Unit 2
Secondary Road (southeast side of Intake Canal)	Unknown, appears in 1957 site plan			No longer in used but road trace is visible.
Railroad Spur	Unknown, appears on 1954 site plan			Abandoned in place
Fuel Oil Service Tank 1 (aka No. 1 Fuel Oil Service Tank)	1954			No known alterations

*Recorded by: Jessica B. Feldman *Date: 10/12/2006 ☒ Continuation ☐ Update

Table continued from Page 4

Name	Year Built	Year Removed	Year Altered	Type of Alteration
Light Oil Tank 2 (aka Diesel Storage Tank)	1954		Unknown	No significant alternations; regular maintenance, etc.
Fuel Oil Service Tank (aka No. 2 Fuel Oil Service Tank)	1958		Unknown	No significant alternations; regular maintenance, etc.
Secondary Regulator Station 1 (aka Secondary Gas Regulator 1)	1958		Unknown	No significant alternations; regular maintenance, etc.
Secondary Regulator Station 2 (aka Secondary Gar Regulator 2)	1958		Unknown	No significant alternations; regular maintenance, etc.
Guard House	Post - 1963		Unknown	
Existing Well	Unknown	Unknown	Unknown	Unknown if this was removed, but it is underneath the site of the Fuel Oil Storage Tank 2.
60kV switchyard	1954			No significant alternations; regular maintenance, etc.
60/12kV Unit Substation	Between 1958 and 1963			No significant alternations; regular maintenance, etc.
Bridge (Salmon Avenue)	Unknown			No significant alternations; regular maintenance, etc.
Primary Regulator Station	1958 – appears at site of Well No. 1			No significant alternations; regular maintenance, etc.
Assembly Building	Between 1958 and 1963			
Training Building	Post – 1963			
Drawing Resources Building	Post – 1963			
Office Building	1991			
Radwaste Treatment (aka Liquid Radwaste Treatment)	1963			No significant alternations; regular maintenance, etc.
Low Level Storage	Post -1963			No significant alternations; regular maintenance, etc.
Contaminated Equipment Storage Building (aka Radwaste Handling Building)	1963			
Hazardous Storage Building	Post – 1963			
Effluent Ponds (2)	Post – 1963			
Processing Slab	Post – 1963			
Office (5-wide)	Post – 1953			Temporary construction

*Recorded by: Jessica B. Feldman *Date: 10/12/2006 ☒ Continuation ☐ Update

Table continued from Page 5

Name	Year Built	Year Removed	Year Altered	Type of Alteration
Misc. Sheds – Painting Office	Unknown, between 1963 and 1999 (as seen on 1999 site plan)	Between 1999 and 2006		No longer on site
Sandblast & Painting Facility	Post – 1999			
Paint & Materials c-vans	Post – 1999			
Storage c-vans	Post – 1999			
Storage Buildings	Post – 1999			
115 kV breaker	Post – 1999			
MEPP Diesel tanks	Post – 1999			
Gas Turbine MEPP 1	Post – 1999			
Gas Turbine MEPP 2	Post – 1999			
Hydrogen Storage	Between 1958 and 1963			No significant alternations; regular maintenance, etc.
Waste Solids Vault	1963	Yes – doesn't appear on current maps		
Machine Shop and Instrument Calibration (aka Hot Shop)	1963			No significant alternations; regular maintenance, etc.
Septic Tank	1963			No significant alternations; regular maintenance, etc.
OCB Unit 3	1963	Yes – doesn't appear on current maps		
Hydrants (*19 are mentioned in "Unit No. 2 Plant Data," Bechtel, 1958, Section 20)	Various	Unknown	Unknown	Probably upgraded; no data available.

*Recorded by: Jessica B. Feldman *Date: 10/12/2006 ☒ Continuation ☐ Update

Photograph 2: Fuel Oil Storage Tanks looking north.

*Recorded by: Jessica B. Feldman *Date: 10/12/2006 ☒ Continuation ☐ Update

Photograph 3: Fuel Oil Storage Tanks looking south. The Office, Fire Pump House and Raw Water Tank are in the foreground. At the far upper left is the Assembly Building and parking area.

Photograph 5: Looking northeast from the catwalks on Unit 1 and 2 at the storage C-vans and a temporary garage structure. The abandoned railroad spur runs under the garage structure. These buildings were intended to be temporary structures.

Photograph 6: Looking southeast from the catwalk on Unit 1 over the roof of the Office towards the entrance at King Salmon Way. The Intake Canal is along the left side of the image. Fuel Oil Storage Tank 1 is at the right, and the Assembly Building is in the background at center.

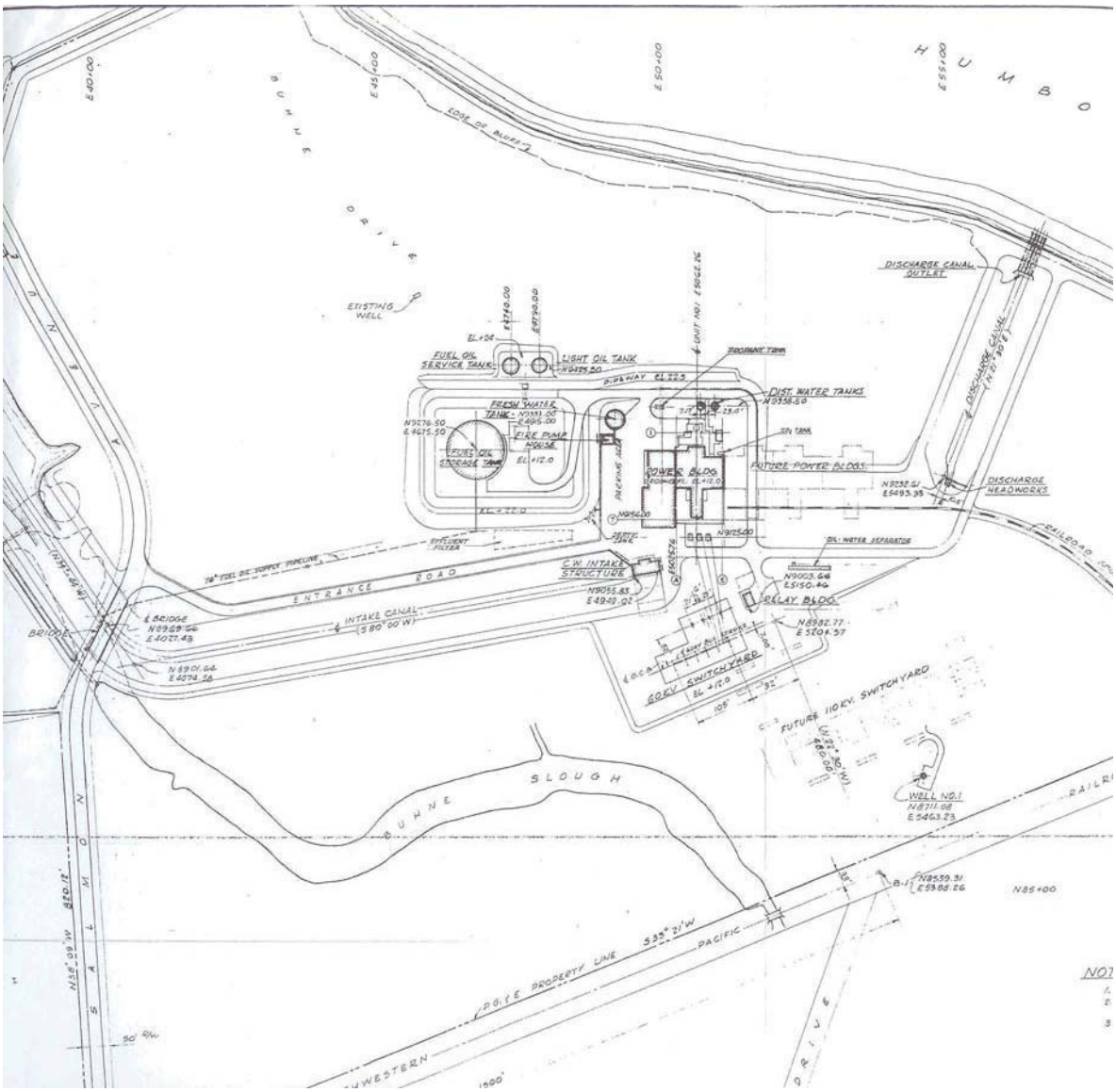
***Recorded by:** Jessica B. Feldman ***Date:** 10/12/2006 ☒ Continuation ☐ Update

Photograph 8: Looking north/northwest with the Liquid Radwaste Treatment building in the foreground and the Low Level Storage and Radwaste Handling Building close to Humboldt Bay. The lower end of the Discharge Canal is at the far right.

Photograph 9: The Discharge Canal, looking west.

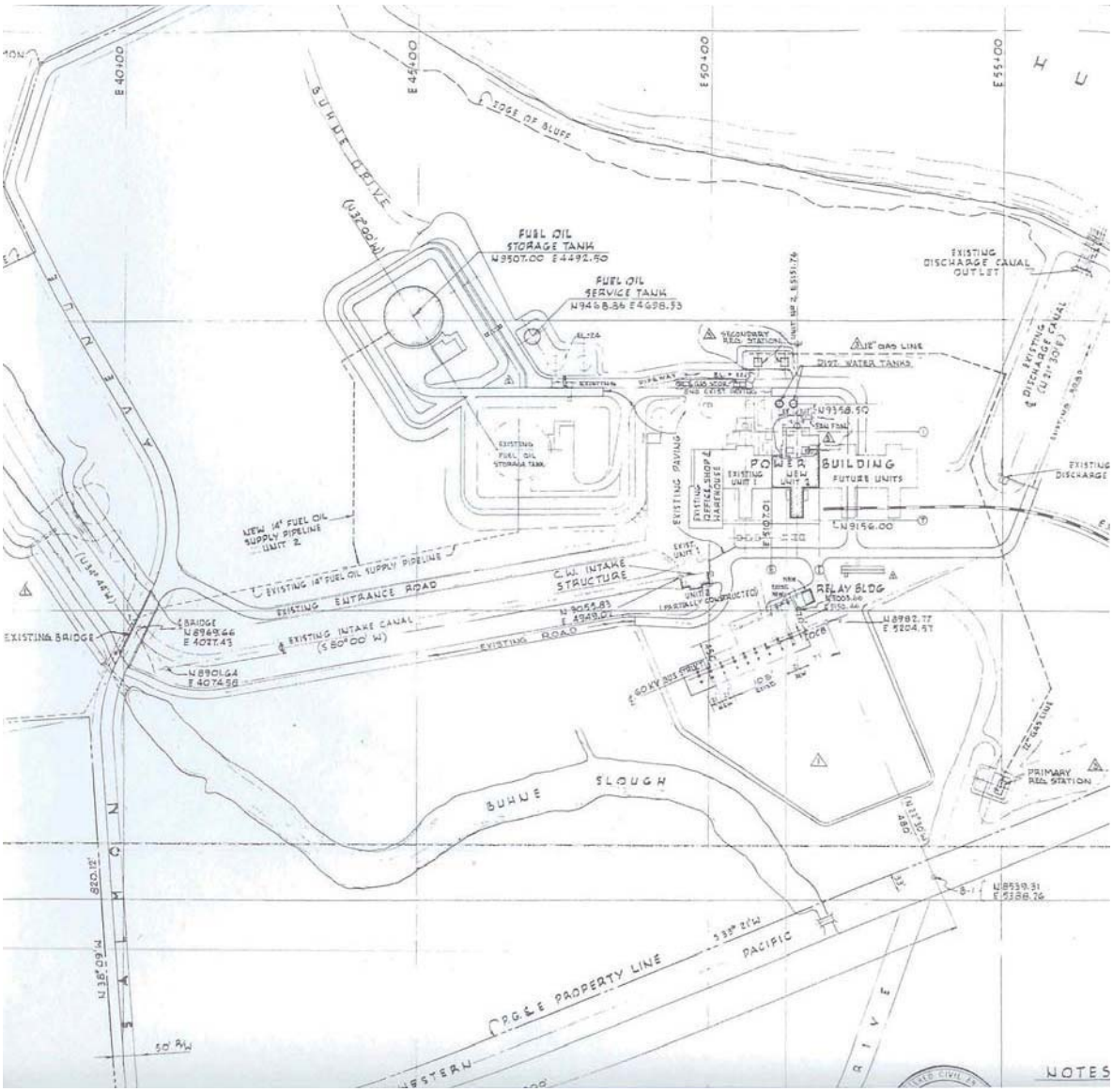
Photograph 10: Looking south/southwest at the railroad spur, which is just visible below the concrete/gravel walk at the lower right. The temporary garage structure is at the top center of the image. This picture was taken in the wetlands area of the property, which is north/northwest of the primary buildings.

Photograph 11: Looking east/northeast over the Relay Building (at center) towards the MEPP Diesel tranks. The Sandblast/Painting Facility is at upper left and the switchyard is at the right.



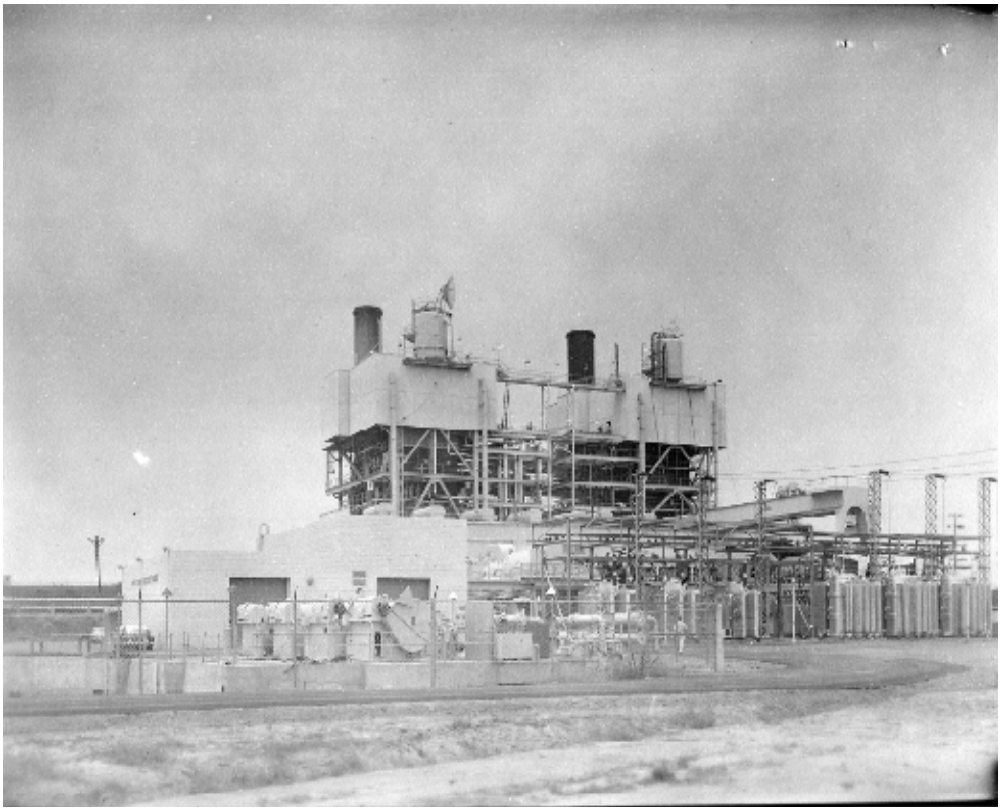
1954-1956 Site Plan section.

*Recorded by: Jessica B. Feldman *Date: 10/12/2006 ☒ Continuation ☐ Update



1956-1957 Site Plan section.

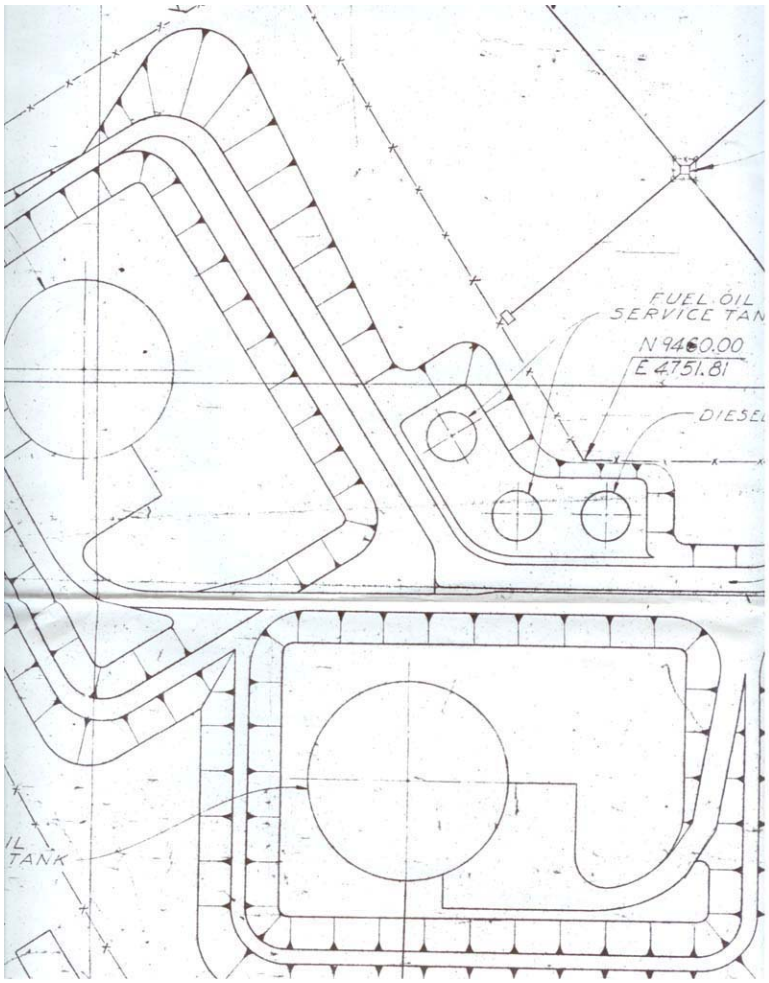
Aerial view of Units 1 and 2, taken between 1958 and 1963, looking southwest, with the community of King Salmon at the top of the image. Note the structures on the north side of Units 1 and 2, which have since been removed. This image is available courtesy of the archives of PG & E.



Looking north/northwest at Units 1 and 2. The Shops and Warehouse extension to the south of Unit 1 is visible on the left. This image is available courtesy of the archives of PG & E.

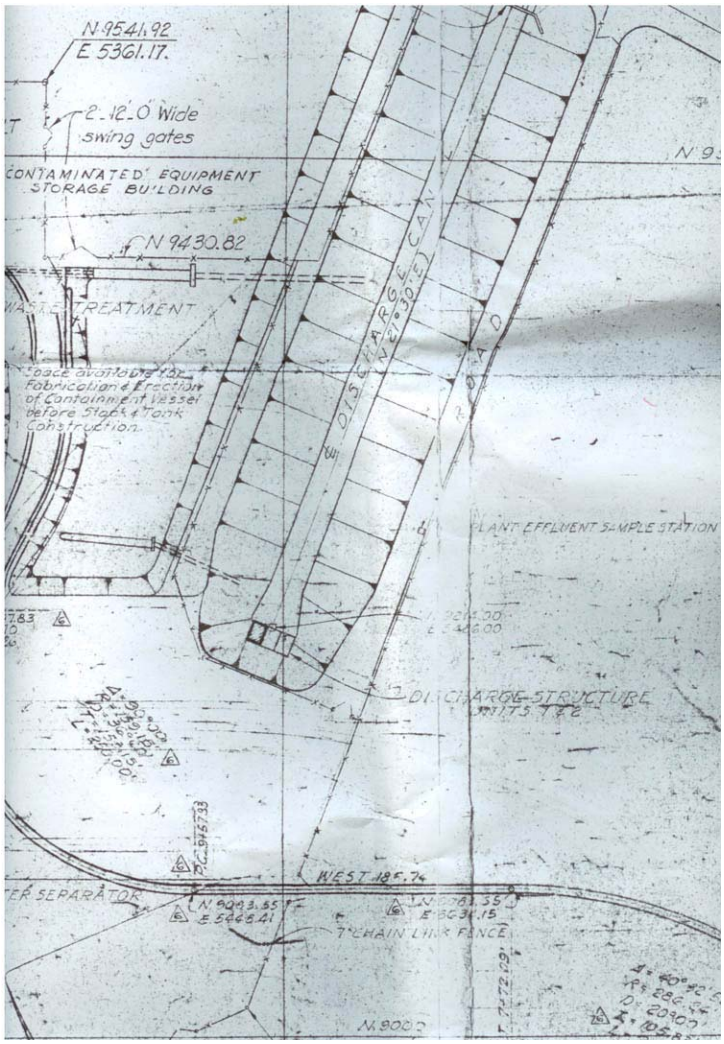
Looking north/northeast from Unit 2 towards the construction/staging area for Unit 3, circa 1963. Note the one-story, gable-roof structures at the upper right and left. These do not appear on any site plans or maps and their year built/removed dates are unknown. This image is available courtesy of the archives of PG & E.

*Recorded by: Jessica B. Feldman *Date: 10/12/2006 ☒ Continuation ☐ Update

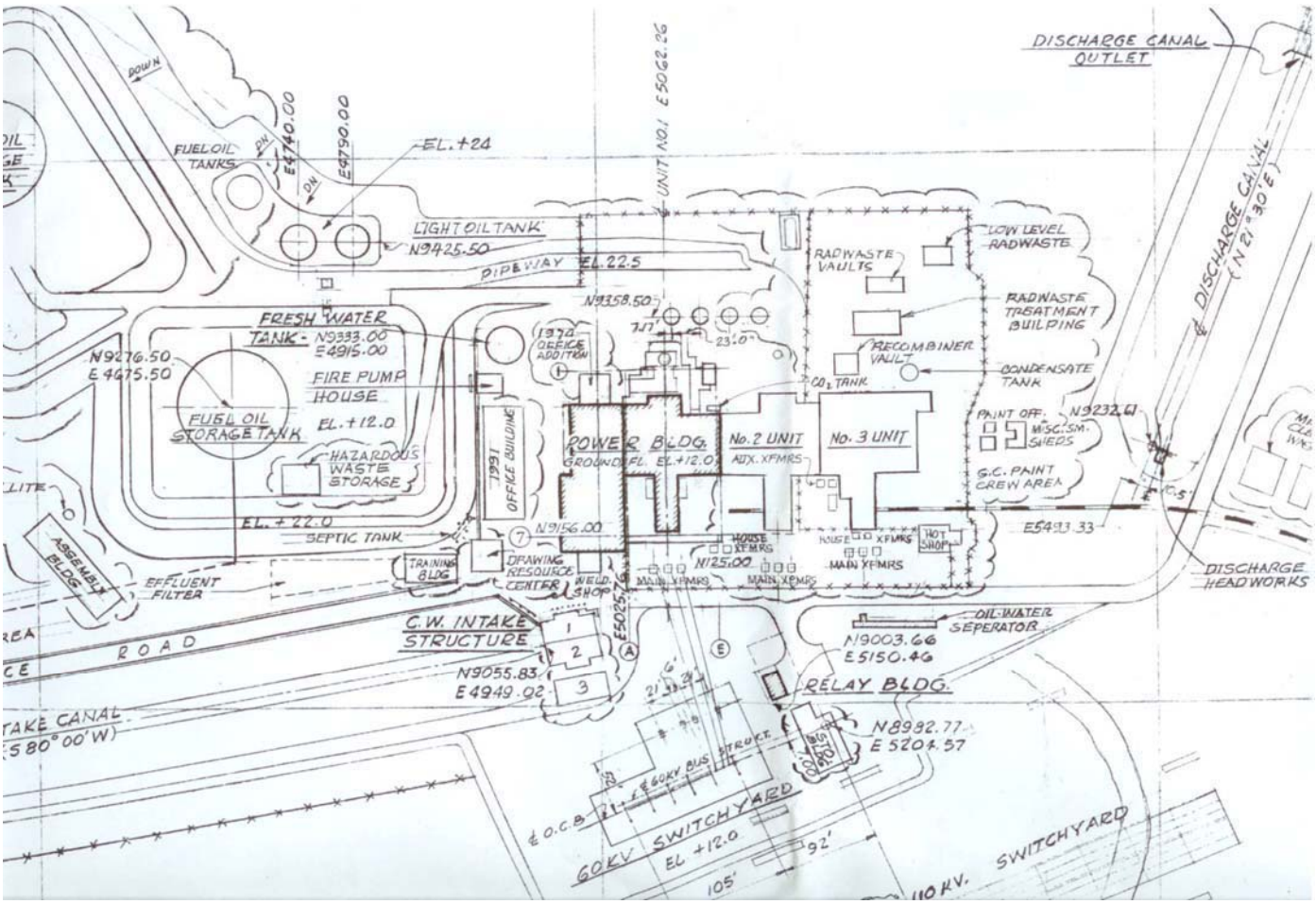


The Fuel Oil tanks from the 1963 Site Plan

*Recorded by: Jessica B. Feldman *Date: 10/12/2006 ☒ Continuation ☐ Update

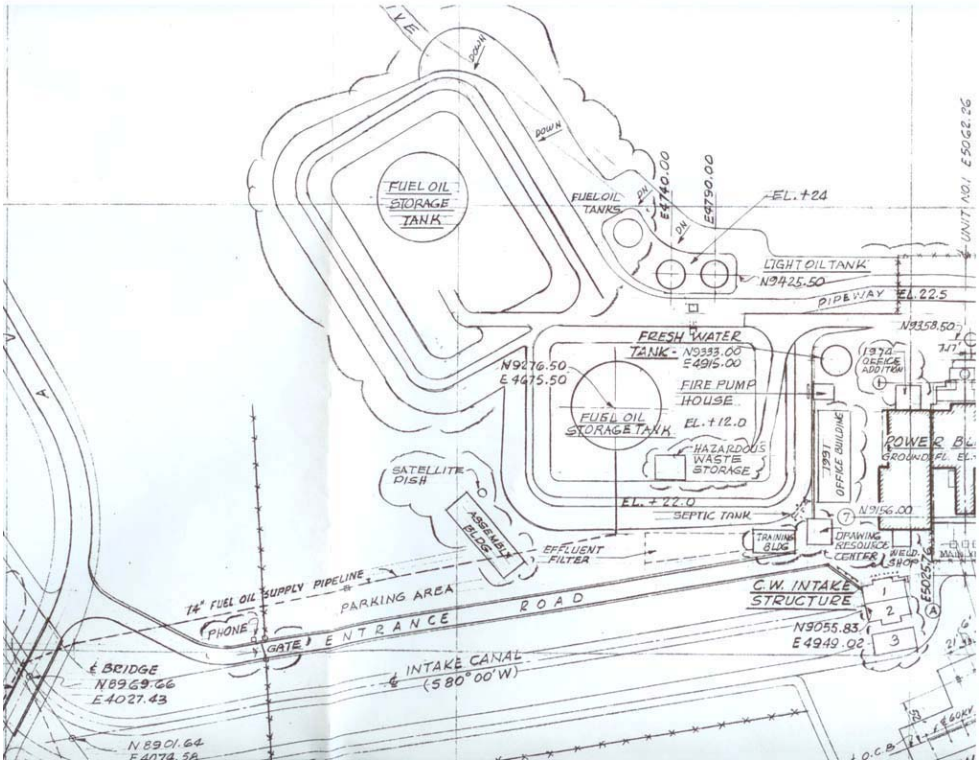


The Discharge Canal and railroad spur from the 1963 Site Plan

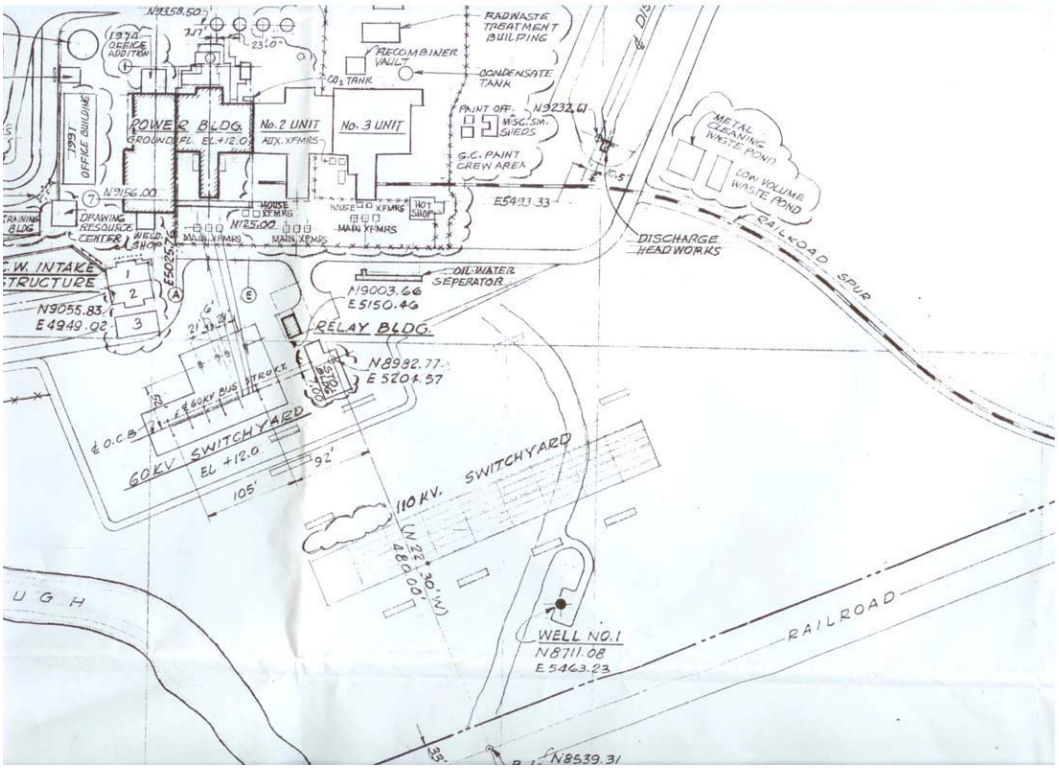


From a revised (1999) site plan, this shows the main concentration of the buildings at the Humboldt Bay Power Plant.

***Recorded by:** Jessica B. Feldman ***Date:** 10/12/2006 ☒ Continuation ☐ Update



From a revised (1999) site plan, this shows the south end of the property.



From a revised (1999) site plan, this shows the north end of the property.

Geology and Paleontology

Data Response 28

Geology and Paleontology (28)

Geotechnical studies

28. Please provide the following:

    a. Copies of any subsequent geotechnical memorandums;

    b. A copy of the geotechnical investigation report once it is completed; and

    c. A schedule for providing the Geotechnical Report.

Response: Final design-level geotechnical investigations have not yet been completed. However, in order to provide additional information to CEC Staff, PG&E commissioned further geotechnical work. A copy of a draft Geotechnical Report is provided in Attachment DR28-1, which expands upon the preliminary findings reported in the Field Memorandum previously submitted with the AFC (Appendix 10G, Attachment 1). PG&E believes that the Draft Geotechnical Report contains sufficient information for CEC Staff to conclude that the site conditions have been adequately characterized in order to support a conclusion that geotechnical parameters can be incorporated into the design sufficiently to ensure compliance with the Uniform Building Code (UBC). PG&E anticipates completion of additional geotechnical investigations and will submit them before construction begins, in accordance with the Commission's standard conditions of certification.

Attachment DR28-1

Draft Geotechnical Report

A Report Prepared for:

Mr. Dale Love
Wärtsilä Finland Oy Power Plants
Wärtsilä North America, Inc.
16330 Air Center Blvd.
Houston, TX 77032

GEOTECHNICAL REPORT
PROPOSED POWER PLANT
HUMBOLDT BAY PG&E FACILITY
EUREKA, CALIFORNIA

Kleinfelder Job No.: 68522

by

Terry Craven, GE 2572
Principal Geotechnical Engineer

Chris Spandau, GE 2083
Principal Geotechnical Engineer

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William V. McCormick, CEG 1673
Principal Engineering Geologist

December 14, 2006

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December 8, 2006
Project No. 68522-1

Mr. Dale L. Love
Wärtsilä Finland Oy Power Plants
Wartsila North America, Inc.
16330 Air Center Blvd.
Houston, TX 77032

Subject: Draft Geotechnical Investigation Report
Proposed Power Plant at Humboldt Bay PG&E Facility
Eureka, California

Dear Mr. Love:

Kleinfelder, Inc. is pleased to present six copies of our draft geotechnical report summarizing our geotechnical investigation performed for the proposed Power Plant. Our exploration logs, laboratory test results, conclusions, and recommendations for geotechnical design of the project, are presented in the attached report.

The conclusions and recommendations presented in this report are subject to the limitations presented in Section 8. We anticipate that additional consultation will be necessary after your structural engineer has more fully developed foundation support concepts; a final report will be issued at that time. We appreciate the opportunity to be of service on this project. If you have any questions, comments, or require additional information, please do not hesitate to contact either of the undersigned at (707) 571-1883.

Respectfully submitted,

KLEINFELDER, INC.

DRAFT

Terry Craven, GE 2572
Principal Geotechnical Engineer

Chris Spandau, GE 2083
Principal Geotechnical Engineer

TNC\jkd

cc: Jukka Lehtonen – Wärtsilä

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Seismic Cone Penetrometer Logs, SCPT-2, SCPT-5 and SCPT-8

APPENDIX B - LABORATORY TEST DATA

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1.0 INTRODUCTION

Kleinfelder, Inc. (Kleinfelder) was retained by Wärtsilä North America, Inc. (Wärtsilä), to conduct a geotechnical investigation at the site of the proposed power plant and associated facilities located at the existing Pacific Gas and Electric Company (PG&E) Humboldt Bay Power Plant (HBPP) in Eureka, California. The location of the site is presented on Plate 1, Site Location. The location of the proposed new power plant and associated structures is currently occupied by several storage sheds, maintenance buildings, and portable structures, which will be moved or demolished to make room for the proposed power plant. These improvements are shown on Plate 2 (Site Geology) and Plate 3 (Site Plan).

The purpose of our geotechnical investigation was to explore and evaluate the general subsurface soil conditions at the location of the proposed power plant site, characterize seismic site conditions, and provide geotechnical recommendations for the design of foundations. This study also addresses the potential corrosivity of the near-surface soils, groundwater levels, and earthwork construction considerations. The scope of our services is contained in our contract dated May 18, 2006, signed by Paul Owens, Wärtsilä North America, Inc. A description of the scope of work performed for this investigation is presented below.

File Review-Previous Studies: Kleinfelder's geologic staff conducted a file review of previous studies completed at HBPP by other consulting firms. The purpose of the file review was to provide a background for the current study as well as aid in field exploration operations. Reports were available at PG&E headquarters, as well as from onsite archives. Previous studies were conducted by Dames and Moore (D&M), Earth Science Associates (ESA), Bechtel, the PG&E Department of Engineering Research (DER), and Woodward Clyde Consultants (WCC) spanning from 1954 through 1987. In addition, we reviewed geologic information and stratigraphic profiles from the 2003 Humboldt Bay Independent Spent Fuel Storage Installation Safety Analysis and Environmental Reports (ISFSI Reports). Information from these reviews

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were used in conjunction with field exploration activities, and then incorporated into the results of this study. The locations of previous explorations are shown on the Location Map, Plate 2.

Field Exploration: Kleinfelder performed twelve (12) subsurface explorations at the site including three drilled borings (KB-3, KB-4, and KB-10) and nine electric cone penetration tests (CPT-01, SCPT-02, CPT-03, SCPT-05, CPT-06, CPT-07, SCPT-08, CPT-09 and CPT-12). The locations and numbering of the explorations were determined by Wärtsilä and are shown on the Site Plan, Plate 3. A member of Kleinfelder's geologic staff (Jamie Wilen) supervised the field operations and logged the drilled borings.

Borings were drilled with mud rotary drilling equipment and ranged in depth from approximately 21.5 to 101.8 feet below the existing ground surface. Borings allow direct observation of soil conditions and also allow sampling of soils. However, sampling is limited to discreet intervals and thin layers or lenses may not be detected. Selected soil samples were retrieved, sealed, and transported to our laboratory for testing. Boring Logs are contained in Appendix A, and are designated as Plates A-2, A-3 and A-4. The boring log legend, including a description of soil classification procedures, is presented on Plate A-1.

Cone Penetration Tests were completed to depths ranging from 22 to 100 feet below the existing ground surface. CPT tests provide a virtually continuous log of soil conditions and also allow in-situ measurements of soil strength and seismic properties. However soil samples cannot be obtained during CPT testing. Downhole seismic measurements were taken at three of the CPT boring locations (SCPT-2, SCPT-5, and SCPT-8). CPT logs and a description of CPT procedures and interpretation methods is also presented in Appendix A.

A Kleinfelder representative (Jamie Wilen) supervised the field operations as well as observed the upper 5 feet of excavated material during hand clearance of the CPT borings.

Exploration logs, together with a description of exploration methods, are contained in Appendix A.

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Laboratory Testing: Laboratory testing was performed on selected soil samples to check field classifications and to provide engineering parameters for geotechnical design. Laboratory testing included moisture content, dry density, sieve analysis, consolidation, and Atterberg Limits (Plasticity Index). Corrosivity testing was performed by Environmental Technical Services (ETS) of Petaluma, California. Results of laboratory testing are presented in Appendix B.

Geotechnical Analyses: Field and laboratory data were analyzed in conjunction with the preliminary development plans to provide geotechnical data for further planning and design. We evaluated potential deep foundation systems (based on the anticipated loading and seismic conditions), lateral earth pressures, and construction considerations. Potential geologic hazards were addressed including ground shaking, liquefaction, seismic settlement, lateral spreading, and seismicity. Results of these analyses are contained in the following sections of this report.

Report Preparation: This is a draft report provided for review by Wärtsilä. After we receive your review comments, this report will be amended as appropriate and re-submitted as a Final Geotechnical Report.

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2.0 SITE AND SUBSURFACE CONDITIONS

2.1 SITE DESCRIPTION

The project is located on the site of an existing PG&E facility in south Eureka, California. The location of the site is shown on Plate 1, Site Location. The PG&E facility is located on an irregularly shaped parcel that is south of Humboldt Bay, east of King Salmon Avenue, and north of the Northwestern Pacific railroad tracks. The proposed new power plant will be located south of the existing facilities in the general location shown on Plates 2 and 3.

The proposed new power plant site is generally level, varying from approximately elevation +10 to +12 NAVD88 (North American Vertical Datum of 1988). It is located approximately 600 feet from the edge of Humboldt Bay. Most of the surface of the site is paved. There are existing one-story buildings and appurtenant facilities on the site that will be demolished as part of the proposed new facility development.

2.2 PROPOSED PROJECT

The project will consist of a new natural gas-fired power plant with a backup petroleum hydrocarbon tank and fueling system. Key components will consist of an engine hall that contains ten engines, each on its own foundation; ten SCR/CO (selective catalytic reduction/oxidation catalyst) units; ten stacks, grouped into two clusters of five stacks each; a large radiator field; a 53-foot-diameter liquid fuel oil (LFO) tank; three large transformers; and miscellaneous small tanks and buildings. Sizes, loads, and settlement sensitivity of major structures and equipment are summarized in the following table.

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Item	Plan dimensions (meters)	Plan dimensions (feet)	Weight (kN)	Weight - metric (Tons)	Weight (kips)	Unit Pressure (kN/sq. meters)	Unit Pressure (psf)	Settlement Tolerance (inches)
Engine Hall								
Total Building	27.7 X 86.7	90.9 X 284	3547		798			
Total Floor Load						16	341	
Engine & Found - ea.	4.8 X 18.1	15.75 X 59.4	6326		1423	73	1526	0.2
SCR unit	3.8 X 5.3	12.5 X 17.4	594		134	29.5	617	
Stack	12 X 8.8	39.4 X 28.9	4096		922	38.8	811	
Radiator Field (including slab)	27.3 X 57.3	89.5 X 188				7	146	
MV Control Cabinet				122.5	270			
LV Building				29.5	65			
Step up Transformers (60 kv or 115kv)	8.3 X 10	27.2 X 32.8	1600		360	19.3	403	
LFO Tank	Dia = 16.2	Dia = 53	20828		4686	113	2362	1

2.3 SUBSURFACE SOIL CONDITIONS

The following paragraphs are based on the geologic information and stratigraphic profiles in the ISFSI reports, other borings at the HBPP, and the results of our field exploration and laboratory testing. The logs from our explorations are presented in Appendix A and should be reviewed for a more detailed description of the subsurface conditions at the locations explored during this study. Typical subsurface sections are provided on Plate 4. Section locations are shown on Plate 3.

2.3.1 Fill

At the time of our explorations, most of the site was covered with asphalt cement pavement. The existing pavement section consisted of approximately two to six inches of asphalt concrete over aggregate baserock and/or blended artificial fill material. Below this pavement as well as

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beneath landscaped areas, we encountered fills consisting of silty clay and sandy clayey gravel varying from two feet thick in the north and to the center of the study area, to six feet thick to the south, east, and west. The fill soils were observed to vary from soft/loose to very stiff/dense and were generally free of organics and debris. The near surface soils are primarily clay-rich with moderate to high plasticity.

2.3.2 Holocene Bay Deposits

Below the fill, highly variable bay and marsh deposits were encountered consisting of clays, silty clays, clayey silts, and occasional clayey sands. These deposits range in thickness from 2-feet thick in the northern portion of the study area to 20-feet thick at the eastern edge, and up to 10-feet thick in the southern portion of the field area. Marsh deposits were observed at depths ranging from 2 to 12 feet below ground surface (bgs), and organics were observed in nearly all locations at varying depths up to 25 feet bgs. In one location (boring KB-10 at 8 to 9 feet) we encountered a thin zone of peat. This peat was not identified in our other explorations and is judged to be an isolated, discrete pocket. Soils generally varied from soft/loose near the ground surface to medium stiff/medium dense at depth, with transitions being highly variable. The clays appear to be normally consolidated and compressible. Several feet of low to moderate plasticity silt was encountered at depths ranging from 12 to 20.5 feet bgs. The dark-colored, odoriferous, and highly-organic nature of this unit distinguishes it from overlying artificial fill and underlying Pleistocene Hookton Formation deposits. Although the area of this exploration is generally at the edge of, or beyond the limits of the ISFSI reports, the distribution and thickness of the Holocene Bay Deposits that we encountered are generally consistent with the stratigraphic sections in the ISFSI reports. Transitions were perhaps more gradual than might be inferred from the ISFSI reports and the presence of Bay deposits at the west end of the site was not anticipated from the ISFSI reports, but these results are not inconsistent with the data in the ISFSI reports.

2.3.3 Pleistocene Hookton Formation (Upper)

Below the Holocene Bay Deposits (and/or beneath on-site artificial fill), we encountered laterally discontinuous beds of clay and silt, and sand and gravel that change laterally with inter-fingering

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and gradational facies changes. Clay beds have more lateral persistence than interbedded sand and gravel layers, and, as such, are good marker horizons when sub-dividing units within the Upper Hookton Formation. In our exploration, this formation ranged from 55 to 85 feet thick from east to west and 70 to 75 feet thick from the northern to the southern portion of the study area. Although the area of this exploration is generally at the edge of, or beyond the limits of the ISFSI reports, the depth and distribution of this formation is generally consistent with stratigraphic sections that are contained in the ISFSI reports. The alternating layers of clay, silt, sand, and gravel in the Upper Hookton Formation can be sub-divided according to lithologic characteristics as follows:

2.3.3.1 First Bay Clay (including silt and clay beds)

Below the Holocene Bay Deposits and/or artificial fill, deposits were encountered consisting of clays, silty clays, clayey silts, and occasional lenses of clayey and silty sands. In our exploration this unit ranged in thickness from 20 feet thick in the east and west portions of the study area to 35 feet thick in the north, central, and southern portion of the study area. Fine-grained soils in this interval generally varied from stiff to hard with depth although some softer soils were noted near the top of this unit. The lateral persistence of the 1st Bay Clay, as well as the uniform nature of the fine-grained soils in this unit, distinguishes it from overlying and underlying units.

2.3.3.2 Upper Sand Beds

Below the 1st Bay Clay, we encountered discontinuous beds of clayey and silty sand inter-fingered with occasional sandy gravel lenses. During our exploration this unit ranged in thickness from 40-feet thick in the western portion of the study area to 25-feet thick in the eastern portion of the study area, and from 20-feet thick at the north end of the study area to 25-feet thick at the south end of the study area. Coarse-grained soils in this interval generally varied from dense to very dense with depth. The density and coarse-grained nature of the material in the Upper Sand Beds distinguish this unit from overlying and underlying units.

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2.3.3.3 Second Bay Clay

Below the Upper Sand Beds, deposits were encountered consisting of clays, silty clays, and clayey silts. In our exploration this unit ranged from 25-feet thick at the western end of the study area to 15-feet thick at the eastern end of the study area and was found to be 20-feet thick from north to south. Fine-grained soils in this interval were typically hard. The lateral persistence of the 2nd Bay Clay, as well as the uniform nature of the fine-grained soils in this unit, distinguishes it from overlying and underlying units.

2.3.4 Pleistocene Hookton Formation (Lower)

Below the Upper Hookton Formation and extending beyond the depths sampled during this study, we encountered laterally discontinuous beds of silty, clayey, and gravelly sand. Coarse-grained soils in this interval were typically dense to very dense with depth. The density and coarse-grained nature of the material in the Lower Hookton Formation distinguishes this unit from the overlying 2nd Bay Clay. Although the area of this exploration is generally at the edge of, or beyond the limits of the ISFSI reports, the depth and distribution of this formation is generally consistent with stratigraphic sections that are contained in the ISFSI reports.

2.3.5 Groundwater Conditions

At the time of our explorations, borings inside the proposed power plant site encountered groundwater at depths ranging from five to six feet. Our explorations were performed during a relatively dry time of year (late July 2006). Seasonal groundwater may rise close to the existing site surface during periods of wet weather and high tides. Localized zones of perched water and variations in soil moisture content can also occur due to seasonal changes. Irrigation of landscaped areas on, and adjacent to, the site can also cause a fluctuation of local groundwater levels. These water levels are consistent with the perched water table discussed in the ISFSI report (fluctuating between approximately elevation +6 and +10). Deeper aquifers that are discussed in the ISFSI reports were not explored for this investigation.

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It should be anticipated that soil and groundwater conditions may deviate from those conditions encountered in the borings. Should this be revealed during construction, Kleinfelder should be notified immediately for possible revisions to the recommendations in this report.

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3.0 LABORATORY DATA

Representative soil samples obtained from the borings were returned to the Kleinfelder laboratory for further examination and testing to refine the field classifications and engineering properties. Laboratory results for each unit are summarized below. Laboratory test results for specific locations and depths are presented on the Boring Logs in Appendix A. A detailed summary of the laboratory testing program and results is presented in Appendix B.

3.1 FILL SOILS

The fill encountered at the site consisted generally of silty clay and sandy clayey gravel varying in depth from about two to six feet thick in scattered locations. The fill soils were observed to be soft to very stiff, medium dense to dense, relatively poor to well compacted, and generally free of organics and debris, as discussed in Section 2.3.1. The results of the limited laboratory testing program on these soils are summarized as follows:

Fine-Grained Fill Soils:

Corrosivity: One test was conducted and the results are presented in Appendix B for general information purposes. A more detailed corrosion analysis will be provided at a later time.

KB-10@3.0 ft

pH = 5.06
Sulfate = 354 ppm
Chloride = 226 ppm
Redox = +357.5 mV

3.2 HOLOCENE BAY DEPOSIT SOILS

Soils associated with Holocene Bay Deposits encountered at the site generally consisted of clays, silty clays, clayey silts, and occasional clayey sands extending to depths ranging in thickness from two to 20 feet thick in scattered locations. Soils generally varied from soft/loose near the

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ground surface to medium stiff/medium dense at depth, with transitions being highly variable, as discussed in Section 2.3.2.

The results of the limited laboratory testing program on these soils are summarized as follows.

Fine-Grained Holocene Bay Deposit Soils:

Corrosivity: One test was conducted and the results are presented in Appendix B for general information purposes. A more detailed corrosion analysis will be provided at a later time.

KB-4@6.0 ft

pH = 5.46
Sulfate = 372 ppm
Chloride = 205 ppm
Redox = +234.1 mV

Unit Weight, Plasticity Index, Grain Size:

Boring	Depth (ft.)	Dry Density (pcf)	Wet Density (pcf)	Moisture Content %	Liquid Limit %	Plasticity Index %	Minus #200 Sieve %
KB-3	7.5			30.8	20	6	
KB-4	6.0	70	101	45.2	50	19	70
KB-4	8.5	92	116	25.4	35	20	
KB-10	3.5	90	114	26.1	30	15	
KB-10	6.0	72	104	44.8	46	18	
KB-10	8.5	51	90	77			
KB-10	10.5	95	117	23	35	14	
KB-10	13.0	78	112	44.1	40	20	
KB-10	15.5	86	111	30.1	38	18	
KB-10	17.5	88	121	37.6	30	14	
KB-10	18.0	83	114	36.9			87
KB-10	18.5	89	119	33.5	26	11	
KB-10	20.5	103	129	25.6	22	9	

Consolidation Tests: Three tests were conducted with the following interpreted results:

KB-4@8.5 ft

Coefficient of Compression (% strain): $C_c/(1+e_o) = 0.11$
Effective Pre-consolidation Stress: σ'_p = not determined

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KB-10@10.5 ft	Coefficient of Compression (% strain):	$C_c/(1+e_o) = 0.13$
	Effective Pre-consolidation Stress:	σ'_p =4000 psf
KB-10@15.5 ft	Coefficient of Compression (% strain):	$C_c/(1+e_o) = 0.13$
	Effective Pre-consolidation Stress:	σ'_p =1800 psf

3.3 PLEISTOCENE UPPER HOOKTON FORMATION SOILS

Soils associated with Pleistocene Hookton Formation deposits encountered at the site generally consisted of laterally discontinuous beds of clay and silt, and sand and gravel. Clay beds have more lateral persistence than interbedded sand and gravel layers. In our exploration this formation ranged from 55 to 85 feet thick. The results of the laboratory testing program on the upper unit are summarized as follows:

Fine-Grained Hookton Formation Soils:

Unit Weight, Plasticity Index, Grain Size:

Boring	Depth (ft.)	Dry Density (pcf)	Wet Density (pcf)	Moisture Content %	Liquid Limit %	Plasticity Index %	Minus #200 Sieve %
KB-4	16			27.5			
KB-4	26	103	125	21.5			
KB-10	21	106	131	23.2			

Consolidation Tests: Two tests were conducted with the following results:

KB-4@26.0 ft	Coefficient of Compression (% strain):	$C_c/(1+e_o) = 0.09$
	Effective Pre-consolidation Stress:	σ'_p = 4000 psf
KB-10@21.0 ft	Coefficient of Compression (% strain):	$C_c/(1+e_o) = 0.07$
	Effective Pre-consolidation Stress:	σ'_p = 5000 psf

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4.0 GEOLOGY

4.1 REGIONAL GEOLOGY

The study area is situated along the eastern margin of the Humboldt Bay basin in Humboldt County, California. The following summary is based on information provided in the ISFSI reports. This area lies within the northern portion of the Coast Range Geomorphic Province, a dynamic region of California subject to complex folding and faulting from tectonic activity within the Cascadia Subduction Zone (CSZ). Basement rock in the region typically consists of graywacke, sandstone, and mudstone with occasional chert, greenstone, basalt, and schist of the Upper Jurassic-Cretaceous age (about 65-140 million years old) Franciscan Complex.

Franciscan Complex basement rocks are overlain unconformably in the study area by Tertiary-Quaternary age (<65 million years old) semi-consolidated to consolidated marine and non-marine sands, gravels, and silts. With the exception of the coastal dunes and sand spits along the west side of Humboldt Bay, these Quaternary deposits are primarily exposed as upland vegetated terraces and small hills. Holocene age (<11,000 years old) unconsolidated fine-grained sands, silts, and clays have been subsequently deposited in valley floor flood plains and along low-lying tidelands and marshes adjacent to Humboldt Bay. Soils of the marsh lowlands typically consist of organic-rich saturated clays, particularly in the proximity of tidal sloughs.

4.2 LOCAL GEOLOGY

The ISFSI reports show the site to be underlain by Holocene Bay Deposits (Qhb), and deposits associated with the Upper and Lower Pleistocene Hookton Formation (Qph). The Hookton Formation consists of middle to late Pleistocene interbedded shallow marine, estuarine, and fluvial deposits. These deposits are characterized as consisting primarily of silt and clay alternating with thinner sand and gravel lenses. Holocene surficial deposits in the study area include alluvial/estuarine marsh sediments consisting primarily of silt, clay, and peat alternating with occasional laterally discontinuous fine-grained sand lenses.

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Our subsurface investigation encountered recently placed artificial fills underlain by Quaternary alluvial/estuarine marsh deposits associated with Humboldt Bay. The bay deposits consist primarily of peat, sands, silts, and clays, as well as discontinuous beds and lenses of sand and gravel.

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5.0 SEISMIC ANALYSIS AND EVALUATION

5.1 HISTORICAL SEISMICITY

According to the 2001 California Building Code (CBC) Figure 16A-2 and Section 1629A.4.1, the site lies within Seismic Zone 4. The project site and its vicinity are located in an area traditionally characterized by moderate to high seismic activity. A number of moderate to high earthquakes have occurred within this area in the past years. Some of the significant nearby events include the 1918 (M6.5) earthquake located west of Eureka, the 1922 (M7.3) earthquake west of Eureka, the 1932 (M6.4) Eureka earthquake, the 1954 (M6.6) earthquake east of Arcata, the 1980 (M7.2) earthquake west of Eureka, and the 1992 (M7.2, M6.6, M6.5) Cape Mendocino/Petrolia earthquake sequences of April 25 and 26 which produced some of the highest peak ground accelerations ever recorded in California. In addition, the 1873 (M6.8) Crescent City earthquake, the 1878 (M6) Punta Gorda region earthquake, the 1884 (M5.8) Kalamath Mountains earthquake, the 1906 (M6.4) Arcata earthquake.

5.2 SITE SOIL PROFILE TYPE

In developing site-specific ground motions, the characteristics of the soils underlying the site are an important input to evaluate the site response at a given site. Based on the results of our field investigation and laboratory tests, the site is underlain by Holocene and late Pleistocene deposits to the exploration depth of about 102 feet in our borings. Some of the sandy and silty layers may liquefy during a seismic event. However, these layers are relatively thin and should not affect the ground motion for low period (less than 0.5 second) structures. Based on our calculations of the shear wave velocity (V_s) data from the seismic cone SCPT-05, the average V_{s30} value in the upper 100 feet (30 m) is about 724 feet/sec (220 m/s). Therefore, we believe that, for the site response study, the site can be classified as Soil Profile Type S_D, per Table 16A-J of the 2001 CBC. Soil Profile Type S_D is defined as stiff soil with shear wave velocities between 180 m/s (600 feet/sec) and 360 m/s (1,200 feet/sec), SPT-N = 15 to 50 blows/foot, or Su = 50 to 100 kPa (1,000 to 2,000 psf) for the upper 30 meters (100 feet).

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5.3 SEISMIC DESIGN PARAMETERS

For a code equivalent lateral force design, we recommend using the procedures provided in the 2001 CBC. The near-source factors N_a and N_v in the code are incorporated into the seismic coefficients C_a and C_v, which are both used to estimate the total design lateral force or shear at the base of the building or structure. The values of these factors depend on the distance of the structure from the fault and the fault type. The near-source factors for each structure can be obtained from Tables 16A-S through 16A-U of the 2001 CBC. The seismic coefficients C_a and C_v can be obtained from Tables 16A-Q and 16A-R of the 2001 CBC, respectively.

For this site, the Little Salmon (onshore) fault should be considered as the source for the near-fault motions since it is the closest significant fault within 15 km of the site (the distance for near-fault considerations). Using the criteria presented in Table 16A-U of the of the 2001 CBC, the Little Salmon (onshore) fault is classified as Seismic Source Type A. Based on the "Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada, to be used with 1997 Uniform Building Code," the Little Salmon (onshore) fault is located within 2 kilometers of the project site. The near-source factors N_a and N_v are, therefore, 1.5 and 2.0, respectively. For Soil Profile Type S_D, the C_a and C_v values are 0.66 and 1.28, respectively. These values are summarized in the table below. Note that the N_a value may be modified in accordance with CBC Sections 1629A.4.2 or 1630A.2.3.2 or other sections as determined appropriate by the structural engineer.

Parameter	Value
Site Soil Profile Type	S_D
Seismic Zone	4
Significant controlling fault, Type	Little Salmon (onshore), A
Fault distance, Magnitude, Slip rate per year	<2 km, M 7.2, 5 mm
N_a	1.5
N_v	2.0
C_a	0.66
C_v	1.28

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5.4 LIQUEFACTION & LATERAL SPREADING

Our analyses of the borings and CPTs indicate nearly all of the Holocene deposits are too clayey to liquefy under ground motions for the design (2001 CBC) earthquake. Although the CPT data indicate significant borderline soils, the soil samples tested generally exhibit a plasticity index greater than 15 and a natural water content mostly less than 0.8 times the liquid limit. Recent work by Bray, et al. (2006) shows that such soils are non-liquefiable. It is possible lenses of clayey or silty sand and lower plasticity silt (such as those encountered in KB-10 at depths of 18 to 21 feet) would experience liquefaction resulting in relatively small settlements on the order of 1 to 2 inches. However, it is our opinion that such lenses are discontinuous and would not result in lateral spreading toward the bay or nearby channels for the current design standards based on CBC. This would also not impact the proposed construction at the site and can be accommodated in the proposed foundation design. This conclusion is consistent with the fact that there were no reported signs of lateral spreading from earthquakes recorded over the last 40 years despite recorded peak ground accelerations of 0.5g. Ground motions this high would likely trigger some sign of lateral spreading if there were continuous zones of liquefiable soil. However, some ground movement may take place in the event of a larger magnitude event from the CSZ.

5.6 SEISMIC REFERENCES

Bray and Rodolfo (2006) Assessment of Liquefaction Susceptibility of Fine Grained Soils, JGGE, Vol. 132, No. 9, September.

California Building Standards Commission (2001), California Code of Regulations, Title 24, California Building Standards Code (CBC).

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6.0 RECOMMENDATIONS

Based on the results of our field work and office studies, it is our opinion that the site is suitable for the proposed construction, from a geologic and geotechnical viewpoint, provided the recommendations presented in this report are incorporated into the planning and design of the project.

6.1 SITE PREPARATION

Prior to general site grading, existing buildings, pavements, rubble, and debris at the location of the proposed improvements should be either ground up or removed and hauled off-site. The concrete from the demolition of the existing buildings may be ground and re-used as general fill, select fill, aggregate base or aggregate sub-base as long as it meets the specifications for each type of material. If used as general or select fill, the ground-up concrete and asphalt should meet the gradation requirements in this section, which may require mixing it with the on-site or imported soils. Active or inactive utilities within the construction area should be protected, relocated, or abandoned. Any pipelines to be abandoned in-place should be filled with a sand-cement slurry. Active utilities to be re-used should be carefully located and protected during construction. Existing piling should either be removed or cut off at least three feet below the *bottom* of any new slabs, pavements, or foundations. Additional stripping or removal of existing fill may be required in structural and floor slab areas as discussed in subsequent sections of this report.

After demolition operations and stripping of the site, the exposed subgrade should be scarified to a depth of 8 inches. Any near surface structures or utilities uncovered by this process should be removed. Scarified areas should be moisture conditioned to 2 to 4 percent over optimum and re-compacted to the recommendations in the following section of this report. Moisture conditioning and re-compaction of the subgrade soils should extend a minimum of 5 feet beyond building limits and 2 feet beyond pavements and flatwork. Buried structures from previous use of the site such as building foundations, underground fuel storage tanks, and hydraulic lifts

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should be completely removed and the resulting excavation should be backfilled with compacted fills. Soft areas, if encountered, will require over-excavation and backfilling with compacted fills. Unit prices for over-excavation and replacement with compacted fills should be obtained during bidding.

We emphasize that natural subgrade conditions at this site are highly variable and they have been made more variable by past grading activities. Site preparation should be observed by Kleinfelder so that we may verify our design assumptions and also check for the presence of deleterious or undesirable material that is exposed in the subgrade.

6.2 SITE FILLS

6.2.1 Fill Thickness

Native soils at this site are highly compressible. Several inches of settlement from the weight of existing fills may have occurred in some areas of the site. Settlements due to the existing site fills are largely complete although we estimate that an inch or so of long term (secondary) settlement may occur during the design life of the new facility. However, any new fills are likely to initiate renewed cycles of consolidation and settlement. Due to the highly variable subsurface conditions at this site, these settlements would be variable and could exceed one inch of settlement per foot of thickness of new fill in localized areas. As such, we recommend that new site fills be limited to only those necessary to establish adequate slopes for drainage and landscaping. If fills greater than one or two feet are planned over large areas of the site, we should be contacted to review settlement estimates.

6.2.2 Fill Material

On-site soils are suitable for use as general engineered fill providing they are free of organics, deleterious matter, and material larger than about 3 inches in diameter size. Some native soils contain an appreciable amount of silt and clay and may require careful moisture conditioning for adequate compaction.

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Should the need for imported soil be required to achieve the desired finish grades, imported soil should consist of select non-expansive engineered fill. The material for select, engineered fill should be free of organics and meet the following minimum criteria:

Plasticity Index	15 or less
Liquid Limit	35 or less
Passing #200	between 8% and 40%
Maximum Particle Size	3 inches

6.2.3 Fill Compaction

Soils should be compacted in accordance with the following requirements.

SUMMARY OF COMPACTION RECOMMENDATIONS	
Area	Compaction Recommendation [3,4]
Subgrade Preparation [4]	Compact upper 8 inches to a minimum of 90 percent relative compaction. Compaction shall be achieved with a minimum of three overlapping passes of a moderately heavy vibratory roller (exerting a minimum of 300 lbs. Of impact force per inch of drum width and with a minimum drum width of five feet).
General Fill (native or import)	Compact to a minimum of 90 percent relative compaction at near optimum moisture content. Clayey soils shall be compacted at 2 to 4 percent over optimum moisture content.
Trenches [2]	Compact to a minimum of 90 percent compaction at near optimum moisture content. Clayey soils shall be compacted at 2 to 4 percent over optimum moisture content.
Pavement and Concrete Flatwork [1]	Compact upper 12 inches of subgrade to a minimum of 95 percent near optimum moisture. Compact Class 2 aggregate base to 95 percent at near optimum moisture content.

Notes:

(1) Depths are below finished subgrade elevation.

(2) In landscaped areas the percent compaction in trenches may be reduced to 85 percent.

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(3) Compaction requirements refer to relative compaction as a percentage of the laboratory standard described by ASTM D-1557. Lifts to be compacted shall be a maximum of 8 inches loose thickness.

(4) Subgrades, fills, and backfill must be firm and stable regardless of the relative compaction.

Grading operations during the wet season may require provisions for drying of soil prior to compaction. If the project necessitates fill placement and compaction in wet conditions, we could provide alternatives for drying the soil. Conversely, additional moisture may be required during the dry months. Water trucks should be made available in sufficient number to provide adequate water during compaction.

6.3 EXCAVATION AND TRENCHING

6.3.1 Guidelines for Temporary Excavations

Excavations must comply with applicable local, state, and federal safety regulations including the current OSHA Excavation and Trench Safety Standards. Construction site safety should be the sole responsibility of the Contractor who should also be solely responsible for the means, methods, and sequencing of construction operations. We are providing the information below solely as a service to our client. Under no circumstances should this information be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

6.3.2 Excavation Characteristics

Drilling at this site was completed with little to moderate effort through the existing soil deposits. Conventional earth-moving equipment should be capable of performing the excavations required for site development provided that underground structures are not encountered.

6.3.3 Temporary Slopes

Excavations at this site may stand vertically for short periods of time but will be prone to collapse suddenly and without warning. Any excavations deeper than 5 feet, or that encounter

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groundwater, should be adequately sloped or shored. Even trenches that are less than 5 feet deep may experience some sloughing of soils into trench excavations. Trenches should conform to the current OSHA requirements for work safety.

Near-surface soils encountered during our field investigation consisted predominantly of saturated clayey and sandy soils. In our opinion, these soils would be considered a Type 'C' soil with regard to the OSHA regulations. For this soil type, OSHA requires a slope inclination no steeper than 1½:1 (horizontal: vertical) or flatter for excavations 20 feet or less in depth. Steeper cut slopes may be utilized for excavations less than five feet deep depending on the strength, moisture content, and homogeneity of the soils as observed during construction.

6.3.4 Trench Backfill

Backfill for trenches or other small excavations should be compacted as noted in Section 6.2.3. Where utility trenches extend from the exterior to the interior limits of a building, native clayey soils or lean concrete should be used as backfill material for a distance of 2 feet laterally on each side of the exterior building line to reduce the trench from acting as a conduit to exterior surface water. Utility trenches located in landscaped areas should also be capped with a minimum 12 inches of compacted on-site clayey soils.

Special care should be taken in the control of utility trench backfilling in the pavement areas. Poor compaction may cause excessive settlements resulting in damage to the pavement structural section.

6.4 FOUNDATIONS

6.4.1 General

The compressible Holocene deposits and variable undocumented fill soils are not suitable to support the main plant structures within the tolerable differential settlement criteria of 5 mm or 0.2 inches. We recommend the engines, engine building and slab, SCR, stacks and step up transformers, and other heavily loaded or settlement sensitive structures be supported on deep

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foundations that derive their support from the Upper Sand Beds in the Hookton Formation (see Section 2.3.3).

The LFO tank will be about 53 feet in diameter and about 40-feet high with an average vertical load for the full tank of about 2,360 psf. The location of this tank was finalized after the field explorations were completed and no borings were performed at this location. Preliminary foundation recommendations for this tank have been provided based on extrapolation from surrounding explorations. An additional exploration will be performed at the tank location prior to final design. Although tanks can typically withstand considerable settlement, we understand that connection tolerances for this tank limit allowable settlement to less than one inch. Our estimated settlement for this tank with a shallow foundation is at least four to six inches. We understand that the construction schedule does not allow time for pre-loading or surcharging and, as such, the tank should be supported on a deep foundation system.

The Radiator foundations are very light and may be supported on fill re-worked in the upper 3 feet with the slab embedded below the existing grade. Settlement of this foundation with essentially no net load increase is estimated to be less than one inch under static conditions.

Light single-story office buildings, which can tolerate foundation settlements of an inch or so, may also be supported on continuous footings with at least three feet of re-compacted fill beneath footings and two feet of re-compacted fill beneath slabs. Footings for these buildings may be designed for an allowable bearing pressure of 1500 psf.

6.4.2 Deep Foundations

Because of the high groundwater table and sandy nature of some of the soils at this site, drilled shafts or deep excavations will tend to cave and slough. As a result, it is our opinion that driven piling offers the best type of foundation support for the proposed facility. The remaining portions of this section assume that driven piling will be used for support of major facilities. If alternate foundation systems, such as augercast piles or proprietary foundation systems, are desired, we should be contacted to review and revise subsequent sections of this report.

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Based on the loading information that we have been provided, it appears that a vertical pile capacity of approximately 50 tons will be most suitable for the majority of site facilities. There are a wide variety of pile types that could be used for this purpose. Selection of a pile type is often a joint decision of the owner, the geotechnical engineer, the structural engineer, and the contractor. Either closed-end 10- or 12-inch pipe piles or 12-inch-square pre-stressed concrete piles are estimated to achieve design vertical and uplift capacities of 50 to 60 tons with 10 to 15 feet of penetration into the dense sand layer. After your structural engineer has calculated foundation and pile stresses, it may be necessary to review pile types.

6.4.2.1 Axial Pile Capacity

As discussed previously, our explorations encountered a dense to very dense sand layer beneath the site. Previous reports have designated this layer as the "Upper Sand Beds of the Hookton Formation." Our explorations encountered the top of this layer at depths of 35 to 45 feet below the existing ground surface. The bottom of this layer was encountered at depths of 55 to 75 feet. The transition between this layer and the overlying and underlying clay layers was often variable and gradational. The sand layer itself consisted of variable lenses and layers of sand and gravel with some silty and clayey zones.

We estimate that either closed-end 10- to 12-inch pipe piles or 12-inch square pre-stressed concrete piles will achieve design vertical and uplift capacities of 50 to 60 tons with 10 to 15 feet of penetration into this dense sand layer. These are design loads intended for use in a working stress analysis and they contain a calculated factor of safety of approximately 3.0. However, actual pile order lengths should not be selected until after a program of driving indicator piling is completed. In addition, to achieve the specified capacities, the piling should be driven to a specified blow count with properly sized equipment. We recommend that final driving criteria be established after the indicator pile driving program. The indicator pile program is discussed in Section 6.4.2.5.

We selected a design load of 50 to 60 kips based on our understanding that this was in the range that could effectively be used for the proposed facility. Larger piling could develop higher capacities, and, if this is desired, we should be contacted to review these recommendations.

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Although open-end pipe piling could also potentially achieve the desired loads, they would require greater penetrations than closed end piling. In some locations the dense sand formation may only be about 20 feet thick. If a pile punches through this layer, it may penetrate another 20 feet or more to the sands of the lower Hookton Formation. We recommend closed end piling to lessen this risk.

The preceding discussions of pile capacity are based solely on considerations of soil strength. The structural engineer should determine allowable pile capacities for the total of all loads (axial and lateral).

6.4.2.2 Pile Down-drag

Although the site appears to be consolidated under the weight of existing fills, some long-term secondary settlement (creep) is likely to occur. Because the settlement tolerances of some structures are extremely low (< ¼”), the piles must be designed to resist downdrag forces from this consolidating layer.

Because the structural capacity of piling must be sufficient to support the combination of the allowable load and the down-drag load, the structural engineer should add down-drag load to the estimated axial pile loads. For the piles listed previously, down-drag loads of approximately 10 tons per pile should be applied. This load is based on the thickest areas of Holocene Bay Deposits. However, the site is variable and we do not recommend trying to vary this value for different areas of the site. If this is a major factor in design, we recommend selecting higher capacity piling (see previous section).

6.4.2.3 Lateral Capacity Analysis Recommendations

We estimated the lateral pile response due to laterally displacing soil using the computer program LPILE Plus 3.0 by Ensoft (Reese et al., 1997). Analyses were performed for both free-head and fixed-head conditions. A free-head pile is allowed to freely rotate (indicative of a pile with minimal penetration into a pile cap); whereas a fixed-head pile is restrained from any rotation at the pile top (indicative of a pile with significant penetration into the pile cap).

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A summary of the analyses for the four loading conditions is provided in the following table.

Lateral Load Data for Driven Piles

Pile Type	Boundary Condition	Applied Lateral Load (kips)	Pier Head Displacement (inches)
Steel Pipe, 10” dia., 0.25” wall	Free Head	6.9	0.5
Steel Pipe, 10” dia., 0.25” wall	Free Head	9.6	1.0
Steel Pipe, 10” dia., 0.25” wall	Fixed Head	13.7	0.5
Steel Pipe, 10” dia., 0.25” wall	Fixed Head	19.3	1.0
Steel Pipe, 12” dia., 0.25” wall	Free Head	8.6	0.5
Steel Pipe, 12” dia., 0.25” wall	Free Head	12.1	1.0
Steel Pipe, 12” dia., 0.25” wall	Fixed Head	16.8	0.5
Steel Pipe, 12” dia., 0.25” wall	Fixed Head	23.8	1.0
Prestressed Concrete 12” square	Free Head	9.6	0.5
Prestressed Concrete 12” square	Free Head	13.5	1.0
Prestressed Concrete 12” square	Fixed Head	18.6	0.5
Prestressed Concrete 12” square	Fixed Head	26.2	1.0

Bending moments for the above cases can be provided once a pile type and displacement have been selected.

Additional lateral resistance can be provided with passive pressure against the pile mats using an allowable passive resistance for seismic loading of an equivalent fluid pressure of 240 pcf. Passive pressure should be neglected in the top one foot of soil unless confined by slabs or pavements. This value includes a factor of safety of approximately 1.5, which generally corresponds to a predicted lateral deflection of less than one-half inch.

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6.4.2.4 Pile Settlement

Under static loading conditions, total settlements of less than ½ inch, and differential settlements of less than ¼ inch are anticipated for single piles designed in accordance with the preceding recommendations.

6.4.2.5 Indicator Pile Program

Because of the variability of soils across this site, we recommend that pile order lengths be based on the results of an indicator pile-driving program. For this program we recommend installing 10 to 15 pilings relatively uniformly distributed across the site. Indicator piling should be of the same type and driven with the same equipment as production piling. We recommend that the length of the indicator piling be 5 feet longer then the maximum anticipated pile length. Although this will probably result in significant pile cut-offs, we believe this flexibility is needed to allow for possible soil variations across the site. Indicator piling can be driven at the locations of production piling and can be incorporated into foundations.

For the three pile types discussed, we recommend specifying a pile hammer energy of at least 20,000 ft.-lbs. The specification should require that the contractor provide details on the proposed driving equipment and methods including proposed pile cushion type and thickness. After this information is received, we recommend that Kleinfelder perform a wave equation analysis on the proposed pile and hammer combination. Final driving criteria will be established based on this information. The contractor should be advised that modifications to the proposed equipment, including the use of a different hammer, may be required if the analysis indicates that the proposed equipment is not sufficient to obtain the desired ultimate pile capacity or is likely to damage the pile during driving. Pile equipment and installation methods should conform to Caltrans Standard Specification Section 49.

6.4.2.6 Load Test Recommendations

Design pile capacities will be based on the results of this exploration, wave equation analyses, and the indicator pile program. Although these methods are adequate for design, improved economy can often be achieved through field load tests. Considering the large number of pilings

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that will be required for this project, pile load tests may result in significant cost savings. If load tests are desired, we recommend conducting a minimum of three tests on piling that are driven specifically for this purpose during or after the indicator pile program. Load tests should be conducted to a minimum of twice the design axial load or to plunging failure, whichever occurs first. Pilings that are successfully tested may be incorporated into the final building foundations. Load test locations should be selected during or after indicator pile driving. Load tests should be performed in general accordance with Caltrans Specifications and with ASTM D-1143.

6.4.2.7 Construction Considerations

Potential Driving Obstructions

Our explorations did not encounter any subsurface conditions that would be expected to obstruct pile driving (with the exception of existing building foundations and slabs). However, up to six feet of undocumented fill were encountered on this site and it is possible that isolated areas of debris could be encountered. If obstructions are encountered, we recommend that they be excavated and the resulting void backfilled in accordance with Section 6.2 of this report. Piling could then be re-driven through the compacted fill. The need for pre-drilling is not anticipated and jetting of piles should not be allowed.

Protection of Adjacent Structures

The potential for damage due to pile driving induced vibrations depends upon a combination of displacement and frequency of the vibration. Particle velocity is generally considered to be the best measure of damage potential because of the method by which it combines displacement and frequency. The following table lists conventionally accepted vibration thresholds for various conditions assuming a 25,000 ft.-lb. pile hammer. Greater vibrations can result from buried obstructions or unanticipated near-surface difficult driving conditions. It is generally recommended that vibrations be monitored on all structures that are located within approximately 50 feet of driven piling. Additional monitoring may be warranted for unusually sensitive structures. If vibrations due to driving exceed the threshold values presented below, then the hammer energy may need to be reduced or the piling may need to be pre-drilled through the upper portion of the driving profile.

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Criteria	Particle Velocity	Distance from the center of driving resistance at which the vibration threshold is likely to be exceeded.
Vibration perceptible to occupants	0.25 cm/sec (0.1 in/sec.)	60m (200 feet)
Vibration objectionable to occupants	1.25 cm/sec (0.5 in/sec.)	15m (50 feet)
Approximate safe level for plaster cracking/cosmetic damage	5.0 cm/sec (2.0 in/sec.)	5m (15 feet)
Approximate safe level for structural damage to well engineered structures	10 cm/sec (4.0 in/sec.)	3m (10 feet)

Existing Facility Condition Survey

We do not expect that pile driving vibrations will be damaging to nearby structures because of the distance from the proposed building location to the closest adjacent structures. However, subsurface conditions in the vicinity of this site are compressive and variable. In addition, if existing structures are already distressed, they may be more susceptible to vibration than newer well-engineered facilities. We recommend that a condition survey of adjacent structures be performed prior to driving piles. As a minimum, the survey should include photographs of the exterior of adjacent structures noting any areas of existing cracks, settlement, or distress so that these will not be mistakenly attributed to pile driving. It would be beneficial to also install survey monuments on the closest buildings to allow monitoring of any vertical and horizontal displacement.

6.4.3 Shallow Foundations

Lightweight buildings and other ancillary structures can be supported on shallow spread foundations if they can tolerate predicted settlements. Because subsurface conditions consist, in part, of undocumented fills, settlements can vary and it is not possible to accurately predict the total amount or distribution of this settlement. To provide a more uniform subgrade, we recommend that, as a minimum, at least three feet of the existing fill be removed from beneath

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all foundations (extending three feet horizontally beyond of the foundation edge) and that compacted fill be installed in accordance with previous sections of this report.

Spread foundations should be designed and constructed in accordance with the following recommendations.

Maximum Applied Load: 3,000 pounds per linear foot (wall load) or 10,000 pounds (point load).

Allowable Maximum Bearing Pressure: 1500 psf
This is a net pressure; the weight of the foundation can be neglected. This value contains a factor of safety of approximately 3 and is intended for use in a working stress analysis; it can be increased by ⅓ for the inclusion of wind or seismic forces.

Allowable coefficient of friction on the bottom of foundation: 0.35
This value assumes good contact between a concrete foundation and the underlying soil. If moisture barriers or other substances are placed beneath footings, the coefficient of friction can be significantly lower. This value contains a factor of safety of approximately 1.5, which generally corresponds to deflections of less than ½ inch.

Allowable lateral (passive) pressure: 240 pounds per cubic foot (pcf) (triangular distribution)
The allowable passive resistance on the face of footings or other embedded foundation elements is an equivalent fluid pressure. Passive pressure should be neglected in the top one foot of soil unless confined by slabs or pavements. This value includes a factor of safety of approximately 1.5, which generally corresponds to a predicted lateral deflection of less than one-half inch.

Estimated Settlement: up to two inches
See previous discussion in this section.

Minimum Footing Width: 18 inches.

Minimum Footing depth: 12 inches below lowest adjacent finished grade.

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Footing concrete should be placed neat against undisturbed soil. The soils exposed in footing excavations should not be allowed to dry before placing concrete. If shrinkage cracks develop in the exposed soils, it may be necessary to remove and re-install the fill. A representative from Kleinfelder should observe all footing excavations prior to placement of concrete to check that the conditions exposed are as anticipated, or to modify our recommendations, if necessary.

6.5 CONCRETE SLABS

6.5.1 Building Floor Slabs

We anticipate that heavily loaded floor slabs or floor slabs that are settlement sensitive (i.e. Engine Hall) will use pile-supported floors. Other areas of the site may use conventional slabs-on-grade if a minimum of two feet of existing soil is removed and replaced with compacted fill beneath the slab. In either event we recommend that the floor slab be placed over at least 6 inches of compacted, free draining crushed rock. The crushed rock will serve as a capillary moisture break and will also provide a firm surface for the placement of reinforcing steel and other construction activities. This crushed rock should have a maximum size of ¾-inch with at least 90 percent by weight retained on a #4 sieve and should be compacted to 95% relative compaction in accordance with Section 6.2.3 of this report. The crushed rock should be placed on a subgrade that is prepared and compacted in accordance with Sections 6.2.3. Heavily loaded floor slabs or slabs that are subjected to wheel loads should be individually designed.

6.5.2 Exterior and Non-pile Supported Flatwork

Because of possible differential settlement between the pile supported structures and surrounding areas, we recommend that exterior concrete flatwork be cast free from adjacent footings or building slabs unless it is structurally designed to span areas of differential settlement. This separation may be accomplished by using a strip of 30-pound felt divider material between the slab edges and adjacent structures. Where concrete flatwork is to be exposed to vehicle traffic, the flatwork should be underlain by a minimum of six inches of Caltrans Class 2 aggregate baserock compacted to a minimum of 95%.

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Utilities may experience differential movements at locations where they enter pile-supported structures. Flexible connections are recommended where possible.

6.6 RETAINING WALLS

Retaining walls are not anticipated to be required for this project. If basement or above grade soil retaining structures are proposed, we should be contacted to provide additional recommendations.

6.7 CORROSIVITY

Two samples of the on-site soils were sent to Environmental Technical Services (ETS) of Petaluma, California for testing to screen for corrosivity potential. The samples were tested in general accordance with California Test Methods for redox, pH, resistivity, sulfate content, and chloride content. The test results are presented in Appendix B. Tests indicate a significant potential for corrosion of steel.

However, these tests are only an indicator of potential soil corrosivity for the samples tested. Other soils found on the site may be more, or less, corrosive. Kleinfelder does not practice corrosion engineering. We recommend that a competent corrosion engineer be retained to evaluate the corrosion potential of the site to review proposed improvements, to recommend further testing, if necessary, and to provide specific corrosion mitigation methods appropriate for the project.

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7.0 ADDITIONAL SERVICES

Review of plans and specifications, and the field observations and testing during construction by Kleinfelder are an integral part of the conclusions and recommendations made in this report. If Kleinfelder is not retained for these services, the client will be assuming Kleinfelder's responsibility for any potential claims that may arise during or after construction. The required tests, observations, and consultation by Kleinfelder during construction include, but are not limited to:

- Review of plans and specifications.
- Observations of site grading, including stripping, removal of existing fill materials, and engineered fill construction.
- Review of proposed pile driving equipment and wave equation modeling.
- Observation of indicator pile driving program.
- Observation of pile load testing and provision of final pile design criteria.
- Observation of production pile driving.
- In-place density testing of fills, backfills, and finished subgrades.
- Observation of controlled water testing.

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8.0 LIMITATIONS

The services provided under this contract as described in this report include professional opinions and judgments based on the data collected. These services have been performed according to generally accepted geotechnical engineering practices that exist in this area (Humboldt County) at the time the report was written. No other warranty is expressed or implied. This report is issued with the understanding that the owner chooses the risk he wishes to bear by the expenditures involved with the construction alternatives and scheduling that is chosen.

The conclusions and recommendations of this report are for the proposed new Humboldt Bay Power Plant in Eureka, California, as described in the text of this report. The conclusions and recommendations in this report are invalid if:

- The proposed project, as described, changes.
- The new power plant building is relocated.
- The report is used for an adjacent or other property.
- The Additional Services section of this report is not followed.
- If changes of grades occur between the issuance of this report and construction.
- Any other change is implemented that materially alters the project from that proposed at the time this report was prepared.

The conclusions and recommendations presented in this report are based on information obtained from the following:

- The 12 subsurface explorations performed for this investigation.
- The observations of our geotechnical engineer.
- The results of laboratory tests.
- Our experience in the area and on similar projects.

The boring logs do not provide a warranty as to the conditions that may exist at the entire site. The extent and nature of subsurface soil and groundwater variations may not become evident

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until construction begins. It is possible that variations in soil conditions between borings could exist between or beyond the points of exploration or that groundwater elevations may change, both of which may require additional studies, consultation, and possible design revisions. If conditions are encountered in the field during construction that differ from those described in this report, our firm should be contacted immediately to provide any necessary revisions to these recommendations.

It is the client's responsibility to see that all parties to the project including the designer, contractor, subcontractors, etc. are made aware of this report in its entirety, including the Additional Services and Limitations sections.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than 3 years from the date of the report. Land or facility use, on and off-site conditions, regulations, or other factors may change over time, and additional work may be required with the passage of time. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

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