SECTION 9.0

Alternatives

The following sections discuss alternatives to the Humboldt Bay Repowering Project (HBRP) as proposed in this Application for Certification (AFC). These include the "no project" alternative, project site alternatives, and technology alternatives. These alternatives are discussed in relation to the environmental, public policy, and regulatory considerations involved in developing the project. The main objective of the HBRP is to produce economical, reliable, and environmentally sound electrical energy to serve Humboldt County and California's North Coast Region.

9.1 Applicability

The Energy Facilities Siting Regulations (Title 20, California Code of Regulations [CCR], Appendix B) guidelines, titled *Information Requirements for an Application,* require:

> *A discussion of the range of reasonable alternatives to the project, including the no project alternative… which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and an evaluation of the comparative merits of the alternatives.*

The regulations also require:

> *A discussion of the applicant's site selection criteria, any alternative sites considered for the project and the reasons why the applicant chose the proposed site.*

9.1.1 Warren-Alquist Act

Notwithstanding these application guidelines, an evaluation of HBRP alternative sites is not required under the Warren-Alquist Act. Alternatives analysis is not required when a natural gas-fired thermal power plant is: (1) proposed for development at an existing industrial site and (2) "the project has a strong relationship to the existing industrial site and therefore it is reasonable not to analyze alternative sites for the project (Public Resource Code 25540.6[b])." The HBRP meets the criteria to be considered a repowering project (Public Resources Code Section 25550.5), as described in Chapter 2.0, Project Description. The existing Humboldt Bay Power Plant site has an industrial zoning designation and has been used to generate power since the 1950s. Only power generation industrial activity has occurred on the site since its development. In addition, the site will be used for the storage of spent fuel rods in the Independent Spent Fuel Storage Installation (ISFSI) for the foreseeable future. Since the HBRP will utilize virtually all the existing infrastructure at the site (transmission, natural gas, water, sanitary sewer) and the historical, current and future use of the site has been for power plant operations, the HBRP clearly bears a strong relationship to the existing site use. The HBRP is, therefore, exempt from an alternative sites analysis.

In addition, as demonstrated by the environmental analyses contained in the AFC, construction and operation of the HBRP will not result in any unmitigated significant environmental impacts. Because there are no residual environmental impacts, there is no

need to conduct an alternative site analysis under the California Environmental Quality Act (CEQA).

In order to cooperate fully with the California Energy Commission (CEC), however, provide a complete analysis, and avoid potential disputes similar to those that have arisen in other proceedings concerning the applicability of an alternative site analysis, and to address applicable sections of the Coastal Act which pertain to an alternatives site evaluation, this section contains an exhaustive alternative sites analysis, even though it is not legally required pursuant to the provisions of the Warren-Alquist Act and CEQA noted above.

9.1.2 California Coastal Commission

Because the project site is located within the California Coastal Zone and the California Coastal Commission is a cooperating agency in the CEC power plant certification process for projects located in the Coastal Zone, this alternatives analysis was also designed to address Coastal Act Section 30233, which pertains to alternatives analysis and the expansion of energy facilities. Construction of the HBRP will require the filling of Coastal Commission jurisdictional wetlands.

The Coastal Act §30233 (a), states in relevant part:

> The diking, filling, or dredging of open coastal water, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this division, where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects, and shall be limited to the following:
>
> 1) New or expanded port, energy, and coastal-dependent industrial facilities including commercial fishing facilities…

The evaluation of the alternative sites that are consistent with these provisions of the Coastal Act is included in the following sections.

9.2 Site Selection

The following alternative site evaluation differs from the typical alternative site evaluations to which the Commission is accustomed. For unregulated developers, an alternative site analysis is performed prior to selection of the site. For the HBRP, however, the alternative site evaluation was performed as part of a public bidding process, which resulted in selection of the current site. Additional analyses were completed by Pacific Gas and Electric Company (PG&E) after selection to verify the validity of the selection made through the bidding process. In addition, the ability to select sites for development of new generation is severely restricted for PG&E because it is a regulated public utility as described below.

The review of alternatives undertaken for the HBRP is limited by the regulatory framework governing PG&E's power procurement activities. California Public Utilities Code section 454.5(a) directs PG&E to file a procurement plan with the California Public Utilities Commission (CPUC), indicating how PG&E intends to meet its obligation to procure power on behalf of its customers. More specifically, section 454.5(b) requires that PG&E's procurement plan include a competitive process through which PG&E may request bids for

procurement-related services. The CPUC has approved a short-term procurement plan for PG&E and established the Procurement Review Group (PRG), a group of varied stakeholders including the Division of Ratepayer Advocates and The Utility Reform Network, with whom PG&E is required to consult throughout the solicitation process (CPUC Decision 02-10-062). The CPUC extended the procurement authority of PG&E on a long-term basis and maintained the requirement to consult with the PRG (Decision 04-12-048). PG&E may meet its demand only by using the set of authorized products and types of transactions authorized by the Commission. The CPUC also directed that all generation resources be obtained through an all-source or renewables solicitation and prohibited PG&E from filing a Certificate for Public Convenience and Necessity (CPCN) for any project, unless the project was selected in a solicitation monitored by an independent evaluator.

The HBRP is one of a number of projects submitted by participants in PG&E's 2004 long-term request for offers (LTRFO). In this solicitation, each project for which bids could be submitted was defined as a particular combination of site and generation technology. PG&E has requested a CPCN from the CPUC for the HBRP pursuant to section 1003.5 of the California Public Utilities Code. If the site for this project was changed, it would become a new project that had not been submitted in the solicitation under the terms of PG&E's protocol. PG&E could therefore not pursue any new site or project without it being previously submitted, in competition with other projects, through another solicitation process. PG&E would in that case lose all of the benefits of almost two years of work to obtain the current project, as well as the agreement and pricing it includes. Moreover, no additional solicitation process for this type of project is currently scheduled, and even if one were initiated, it would require more than a year to complete.

9.3 Project Objective

The project objective for the HBRP is to replace the existing Humboldt Bay Power Plant Units 1 and 2, which are 50 years old and are nearing the end of their useful lives, with new, highly reliable generation, which is cleaner and more efficient. The existing Humboldt Bay Power Plant currently provides, and the new HBRP will provide, a large percentage of the electrical power used in Humboldt County; an electrical service area that can be called the Humboldt load pocket. Project design objectives and goals, including the choice of repowering technology and the choice of power plant location, are all shaped by the particular conditions of the Humboldt Load Pocket, in terms of electrical demand, import constraints in the region, and limited gas curtailments that can sometimes occur.

The Humboldt Load Pocket can be defined as consisting largely of the greater Humboldt County area. In terms of electrical demand, it functions almost as an island at the northwest extremity of PG&E's system. Imports to and exports from the load pocket are constrained due to the existing structure of the transmission system. The Humboldt Load Pocket has a current peak demand of roughly 196 megawatts (MW). Load is projected to increase at a rate of 1 MW per year for the foreseeable future. Only half of the current peak demand can be imported into the area. In addition, winter storms regularly upset the transmission infrastructure and, considering the remoteness of much of the transmission system, it is imperative that reliable generation with rapid response capability be located within the load

pocket. For these reasons, regional electricity demand is largely served by the existing Humboldt Bay Power Plant.

While the Humboldt Load Pocket is defined geographically by the county borders, it can be defined electrically by the transmission system that brings much of its power from outside of the region. This transmission system consists of a single 115-kilovolt (kV) transmission line that imports electricity from outside the Humboldt load pocket. The remainder of the transmission system in Humboldt County consists of a network of 60-kV transmission lines. The Humboldt Bay Power Plant is at the nexus of this transmission system. From the existing plant, 60-kV lines extend to the south, east, and north. A 115-kV transmission line, constructed initially for the Unit 3 nuclear power plant, exports power from the Mobile Emergency Power Plant (MEPP) units. The MEPPs are two 15-MW gas turbines that run on diesel oil. Both the 115-kV and 60-kV systems are necessary to reliably support the full output of the HBRP. Therefore, any alternative site must provide feasible access to interconnect to both the 115-kV and 60-kV systems. Although many possible power plant locations have 60-kV transmission lines service nearby, the distances of prospective sites to 115-kV service vary considerably. Whereas upgrading an existing 60-kV system with larger conductors on existing towers to increase their reliability is a relatively simple matter, adding 115-kV service would involve acquiring an entirely new right-of-way and installing new support towers. The cost and environmental impact of such construction would be very high. For this reason, we have assumed for this analysis that building a new transmission line of greater distance than 10 miles would be economically infeasible, may result in greater or unacceptable environmental impacts, and would likely receive little public support.

9.4 Site Comparison Criteria

As stated above, because the HBRP was found to be feasible to undertake at the existing power plant site (it was the result of a publicly bid competitive process that complied with PG&E's approved procurement plan and the regulatory constraints associated with utility-owned new generation), PG&E did not conduct a siting study prior to proposing the HBRP at the existing plant site. While the Commission has reviewed many AFCs for merchant and unregulated public utilities, often containing a summary of such siting studies that explain the methodology by which an applicant has selected a particular site, the following analysis was prepared after the bidding process produced the current site and configuration for the HBRP. However, in conducting an alternatives analysis to meet the requirements of Title 20, Appendix B *Information Requirements for an Application,* as if they were applicable to the HBRP, the following siting criteria were considered important. An alternative site should be located:

- Adjacent to or near an existing substation where constructing additional transmission lines would be minimal or would not be necessary
- Adjacent to or near high-pressure natural gas transmission lines
- On a parcel zoned for industrial land use
- On a parcel large enough to accommodate the site
- Where potential environmental impacts can be mitigated and minimized

The HBRP site, as stated above, is a repowering of the existing Humboldt Bay Power Plant, which will cease operation as a result of construction and operation of the new plant. The site is served by a 115-kV and several 60-kV transmission lines, as well as by a natural gas pipeline with sufficient capacity to serve the project. Under other circumstances, the availability of a supply of recycled water for cooling would be an important criterion for comparing and judging alternative sites. In this case, the technology chosen, the Wärtsilä 18V50DF reciprocating engine, uses a closed-loop air radiator cooling system, and therefore uses very little water for cooling. In addition, as demonstrated by the analyses contained in this AFC, the project would not result in any significant environmental impacts and in many areas will result in significant environmental improvements. Therefore, as will be demonstrated below, there are no alternatives that would be preferred over the project as proposed.

9.5 The "No Project" Alternative

If the Applicant was not to build the HBRP (the "no project" alternative), it would not be possible to meet the project objective of the replacing the Humboldt Bay Power Plant. The "no project" alternative would forego all of the benefits associated with the HBRP project. The Humboldt Bay Power Plant Units 1 and 2 and MEPPs would continue operation in order to support the electrical demand in the Humboldt load pocket. The environmental and economic advantages that the HBRP would otherwise allow to be realized would not occur. The existing units would continue to convert fuel to electricity at a 13,981 British thermal units per kilowatt hour (btu/KWh) heat rate, 33 percent less efficient than the HBRP and, as a result, significant fuel reduction savings would not be realized. The HBRP's 83 percent reduction in ozone precursors, 77 percent reduction in PM_{10} precursors, and 34 percent reduction in CO_2 air emissions, compared with the existing units, would not be realized. The existing ocean water once-through cooling system would continue to operate, using 52,000 gallons per minute (gpm) of ocean water from Humboldt Bay.

In summary, the "no project" alternative would not serve the growing needs of Humboldt County and California's businesses and residents for economical, reliable, and environmentally sound generation resources. Moreover, it would deprive the region of the significant benefits (air quality, water usage, efficiency) that HBRP provides.

9.6 Power Plant Site Alternatives

For comparison purposes, alternative sites were chosen that could feasibly attain most of the project's basic objectives. The alternative sites are shown in Figure 9.6-1. Table 9.6-1 lists the sites and their characteristics.

The methodology used to select the alternative sites was as follows:

1. Obtain a list of vacant industrial parcels in Humboldt County from the Humboldt County Community Development Services Department, Planning Division on-line database of industrial and commercial parcels (includes parcels within City jurisdictions within the County).

2. Prepare a map showing the locations of all of the parcels. The few parcels more than 20 miles from the HBRP or City of Eureka were eliminated from further consideration.
3. Conduct a field visit to the sites of the remaining parcels to assess land use and biological resources impacts.
4. Prepare a table of the parcels, including their acreage, ownership, and zoning.
5. Eliminate parcels unsuitable because of zoning or other factors, in consultation with the Planning Department of the local jurisdiction. Parcels zoned as Commercial, Coastal Dependent Industrial[1], Agricultural, and Natural Resources were eliminated from further consideration. Parcels adjacent to residential areas were eliminated. Two parcels were eliminated because they have recently been developed.
6. Evaluate the parcels based on their zoning, distance to sensitive receptors, distance to electrical transmission and natural gas service, and potential environmental impacts.

Three sites were added to the list that were not included in the County's database. These included two underutilized lumber mill or forest products storage areas. The third site was added because of its location where existing 60-kV and 115-kV transmission lines cross a natural gas pipeline.

The sites that are highlighted in Table 9.6-1 were not eliminated because of zoning, adjacent residential uses, or other obvious fatal flaws. Two sites that were also eliminated because environmentally sensitive habitats (dune hollow wetlands) are present on these sites in a configuration that may prevent power plant siting. These are, however, substantially the same as two other adjacent sites being considered. Following are descriptions of the remaining sites that were compared, listed roughly in order from south to north.

9.6.1 Palco Scotia

This site was not located through the vacant parcels database, but rather through a local source, who indicated that a portion of Palco's Scotia lumber operation could come up for sale at some time in the future. A field visit showed that the northern portion of the Palco facility in Scotia appears to be currently unused or underused. The site is a brownfield site, approximately 10 acres, zoned Industrial, but is not served by 60- or 115-kV transmission lines or natural gas pipeline.

9.6.2 Eel River Mills

The parcel listed in the Planning Department database is an abandoned log landing for the former Eel River lumber mill, but the adjacent mill is also abandoned. The log landing parcel is a level 9.7 graveled acres, zoned as Industrial, located immediately north of the Eel River and adjacent to U.S. 101, in a rural area just north of the community of Rio Dell. Transmission at 60 kV is available adjacent to the site, and a natural gas pipeline is nearby.

[1] The HBRP is considered a coastal dependent facility since it is a repowering of the existing Humboldt Bay Power Plant. The HBRP will also use the same infrastructure as the existing plant. Because this infrastructure is essential for the HBRP to operate, and the infrastructure is being used by a coastal dependent facility, the Humboldt Bay Power Plant, the HBRP is in turn, coastal dependent.

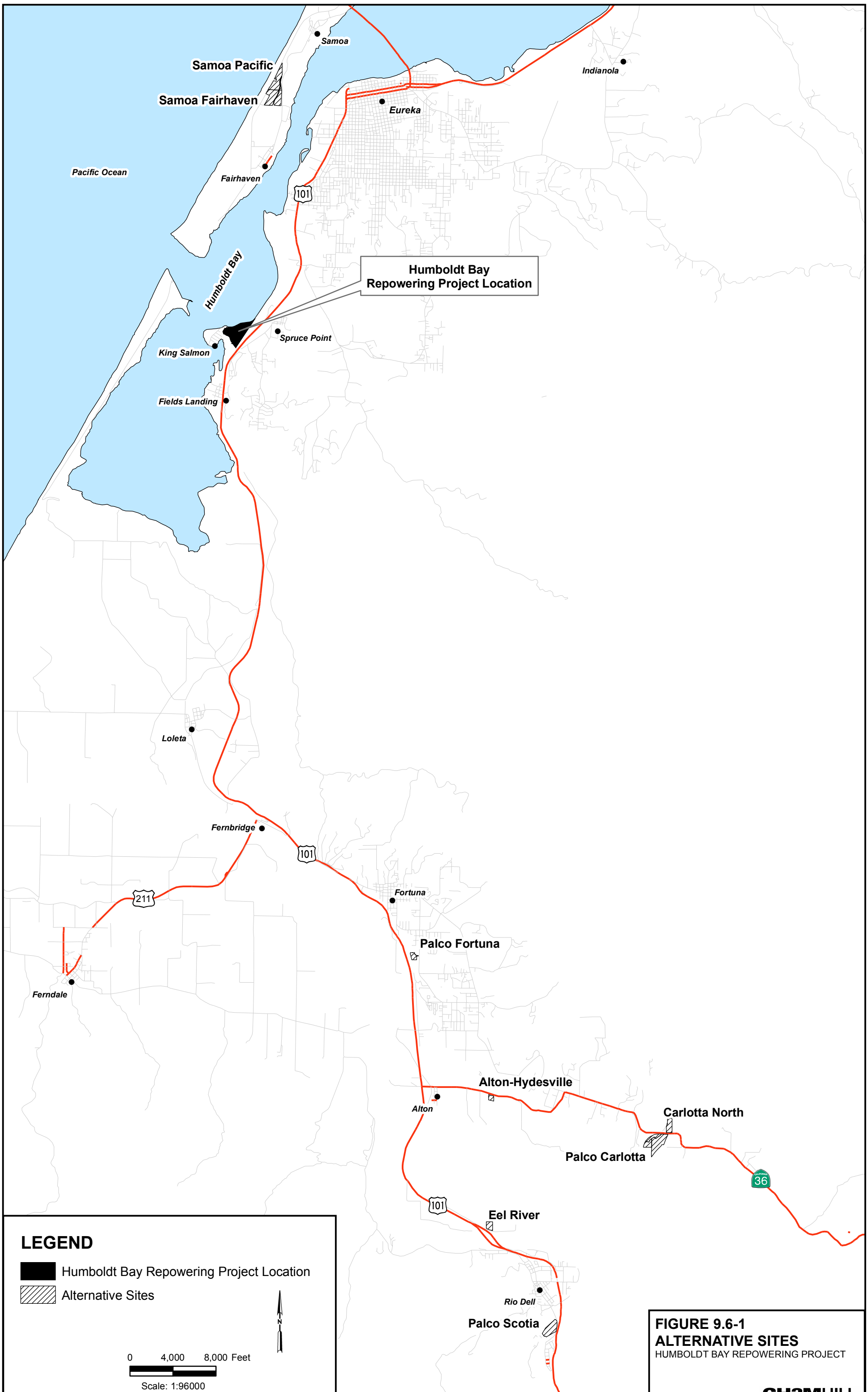

FIGURE 9.6-1
ALTERNATIVE SITES
HUMBOLDT BAY REPOWERING PROJECT

CH2MHILL

File Path: Glacier\PROJ\342077_HumboldtBay\Mxds\Alternative_Sites.mxd, Date: August 9, 2006,

TABLE 9.6-1
Vacant Industrial Parcels in Humboldt County

Parcel	Location or Name*	Current Use	Acres	Miles to natural gas	Miles to 60 kV	Miles to 115 kV	Coastal Zone	Zoning	Constraints
-	Palco Scotia	Vacant lumber mill	~10	2.3	0.6	21.2	-	Industrial	Transmission, gas
-	Rio Dell Substation	Pasture	8.9	1.5	On-site	20.8	-	Unknown	Residential, transmission, gas
20511112	Eel River Mill	Vacant lumber storage	9.7	Adjacent	1.7	18.9	-	Heavy Industry	Transmission
20610124	Carlotta North	Equipment storage	14.7	0.5	On-site	19.7	-	Heavy Industry	Transmission, riparian
-	Palco Carlotta	Vacant lumber operation	~40	0.1	0.2	19.2	-	Industrial	Transmission
20132201	Alton-Hydesville	Vacant chip mill	5.3	Adjacent	1.5	16.8	-	Heavy Industry	Transmission
20202117	Palco Fortuna	Former log deck	7.6	0.1	1	13.3	-	Heavy Industry	Transmission, land use, flood prone
20034110	Fortuna, west of 101	Gravel operation	37.5	0.1	1.5	12.4	-	Agriculture	Transmission, current use
30710108	Fields Landing	Storage, light industry	15.7	0.8	1.4	1.4	Yes	Coastal Dep Industry	Zoning, coastal zone, linears
-	Elk River Road	Pasture	~15	On-site	On-site	On-site	Yes	Agriculture	Wetlands, prime agricultural land
01715107	Myrtletown, Eureka	Gas metering	7.1	On-site	0.5	0.5	Yes	Agriculture	Wetlands, residential, zoning
00223113	Eureka harbor	Vacant dredge spoils	10.5	1.5	2.5	2.5	-	Commercial	Zoning, coastal zone
40113104	South Samoa - Simpson	Open space	67.5	8.5	Adjacent	15.6	Yes	Gen Industrial	Coastal zone, dune hollow wetlands
40111107	Samoa Pacific	Open space	31.4	7.4	Adjacent	14.4	Yes	Gen Industrial	Coastal zone, transmission, gas
40113108	South Samoa - Simpson	Open space	40.7	8.2	Adjacent	15.3	Yes	Gen Industrial	Coastal zone, dune hollow wetlands
40112112	Samoa Fairhaven	Open space	43.9	7.9	Adjacent	15.0	Yes	Gen Industrial	Coastal zone, transmission, gas
40112204	South Samoa - Samoa Pacific	Open space	18.9	8.0	Adjacent	14.9	Yes	Coastal Dep Industry	Zoning, coastal zone, linears
40102129	Mid-Samoa - Simpson	Open space	120.1	6.1	Adjacent	13.1	Yes	Natural Resources	Coastal zone, ESH, transmission

TABLE 9.6-1
Vacant Industrial Parcels in Humboldt County

Parcel	Location or Name*	Current Use	Acres	Miles to natural gas	Miles to 60 kV	Miles to 115 kV	Coastal Zone	Zoning	Constraints
40101101	Mid-Samoa - Simpson	Open space	66.3	5.8	Adjacent	12.8	Yes	Natural Resources	Coastal zone, ESH, transmission
50606124	North Samoa - ATV Club	Recreation	42.4	3.0	Adjacent	10.3	Yes	Natural Resources	Coastal zone, ESH, transmission
50618106	North Samoa - Sierra Pacific	Open space	11.9	3.0	Adjacent	10.1	Yes	Natural Resources	Coastal zone, wetlands, linears
50525110	Southwest Arcata	Pasture	6.6	Adjacent	1.0	7.1	Yes	Agricultural	Coastal zone, wetlands, zoning
50516111	Northwest Arcata	Agricultural, pasture	15.9	0.2	1.0	8.2	-	Agriculture	Adjacent residential district
50613101	Northwest Arcata	Open space	12.0	0.2	1.5	8.8	-	Agriculture	Residences <500 feet, transmission
50714142	Northeast Arcata	Storage, light industry	21.7	0.8	0.6	9.8	-	Limited Industry	Zoning, adjacent residences, riparian
50730109	Northeast Arcata	Pasture	11.2	0.5	0.4	12.2	-	Residential Agriculture	Zoning, transmission
51616116	Glendale	Pasture	20.4	4.6	Adjacent	16.2	-	Unclassified, dispersed res	Transmission, gas
51615119	Glendale	Open space	12.0	4.4	Adjacent	16.4	-	Unclassified, dispersed res	Transmission, gas
51610140	Glendale	Vacant, cleared	9.8	4.2	0.2	16.5	-	Unclassified, dispersed res	Residential adjacent, gas
31216120	Blue Lake	Pasture	32.1	5.7	0.3	18.1	-	Industrial	Transmission, gas, riparian

Source: Humboldt County Community Development Services Department, Planning Division: http://www.co.humboldt.ca.us/planning/indsites/form.asp
* Parcels listed in order, south to north
ESH = Environmentally Sensitive Habitat (Coastal Act or Local Coastal Plan definition)

Selected for further analysis

9.6.3 Carlotta North

This site consists of a 14.7-acre vacant parcel zoned for Heavy Industry, in a rural location along State Route 36. Most of this acreage, however, is occupied by Yager Creek and its riparian zone. There does appear to be enough remaining acreage, however, for siting the HBRP. This site is currently occupied by a sawdust incinerator, trailer, and miscellaneous equipment. A small substation is located across Yager Creek from the site and is served by a 60-kV transmission line. A natural gas pipeline runs on the south side of State Route 36, a short distance away. This site is surrounded by rural residential and agricultural uses.

9.6.4 Palco Carlotta

Palco's Carlotta Division consists of a very large (approximately 40 acres), fenced, utility yard directly across State Route 36 from the Carlotta North site. Although this site was not listed in the vacant parcels database, it appears to be underutilized. As is the Carlotta North site, this site is served by 60-kV transmission and natural gas (which appears to be on site). The site is cleared and portions are graveled. A small amount of logging equipment and timber handling facilities are located there. This site is surrounded by rural residential and agricultural uses.

9.6.5 Alton-Hydesville

This site consists of an abandoned chipping mill located along the south side of State Route 36, about midway between Alton and Hydesville. The mill facilities are still present. The site is 5.3 acres, zoned Heavy Industry and is served by 60-kV transmission and natural gas lines, and is surrounded by agricultural uses.

9.6.6 Palco Fortuna

This site is the 7.6-acre former log deck of the Palco Fortuna mill, now vacant. It is surrounded by mostly urban and suburban land uses of the City of Fortuna (shopping strip-malls), and by U.S. 101. A natural gas pipeline runs adjacent to the site along U.S. 101. A 60-kV transmission line and an electrical substation are approximately one mile east. The City of Fortuna has plans, however, to rezone and redevelop this parcel for commercial uses.

9.6.7 Samoa Pacific

This 31.4-acre site is located on the Samoa Peninsula adjacent to the existing Samoa pulp and chip mill. The site is vacant, zoned as General Industrial, and consists of sparsely vegetated sand dunes. The site is served by 60-kV transmission. It would be necessary to construct a 7.5-mile-long natural gas pipeline to this site. The parcel is surrounded by open space and industrial uses.

9.6.8 Samoa Fairhaven

This 43.9-acre site is located on the Samoa Peninsula, adjacent to the existing Fairhaven biomass power plant. The site is vacant, zoned as General Industrial, and very similar to the Samoa Pacific site. It is served by 60-kV transmission. It would be necessary to construct a

7.8-mile-long natural gas pipeline to this site. The parcel is surrounded by open space and industrial uses.

9.7 Comparison of Alternative Sites

Examination of the alternative site characteristics shows that, although there are appropriately zoned sites that are not located near sensitive receptors or sensitive environmental resources, none of them are located near enough to electrical transmission and natural gas infrastructure to be feasible alternatives to repowering the HBRP at the existing site. While all of these sites are served by 60-kV transmission, the existing service is not designed for loads that would be required to export power from the HBRP. For this reason, very costly upgrades of the existing 60-kV transmission system would be necessary, ranging between $40 million and $90 million.

In addition, all of the sites considered are located more than 10 miles from the nearest 115-kV transmission line (the nearest, Fortuna Palco, is 13.3 miles; the farthest, Palco Scotia, is 21.2 miles). Serving any of these sites with 115-kV transmission capability would require acquisition of several miles of new right-of-way, much of it in the Coastal Zone, for constructing a new generation tie-line. In order to supply the Humboldt load pocket in the manner that is required, a new 115-kV transmission line would likely need to interconnect at either the Humboldt Substation located in Eureka or at the existing Humboldt Bay Power Plant substation. The cost of building this line would be very high and environmental impacts could be substantial. These might include, in particular, loss of wetlands and endangered species habitat, and visual resources impacts.

In addition to requiring the construction of a 115-kV generation tie-line, the two Samoa Peninsula sites would require construction of more than 7 miles of natural gas pipeline. While much of this construction would be placed in existing roadway utility corridors, connection with the existing natural gas trunk line near U.S. 101 in Arcata would require horizontal directional drilling under several major waterways that drain into the north end of Arcata Bay, running the risk of damaging sensitive fish and invertebrate habitat.

Because of the costs of transmission right-of-way acquisition, design, construction, and environmental mitigation, none of the comparison alternative sites would be feasible.[2] In addition, since there will be no significant environment impacts associated with the construction and operation of the HBRP, there is no need to carry the alternative analysis further.

9.8 Alternative Project Design Features

The following section addresses alternatives to some of the HBRP design features, such as the locations of the natural gas supply pipeline, electrical transmission line, and water supply pipeline.

[2] Section 30108 of the Coastal Act defines 'feasible' as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economics, social, and technical factors." The time and costs associated with permitting and constructing a 115-kV transmission line would prevent any of the alternative sites in this analysis from being considered feasible, as defined under the Coastal Act.

9.8.1 Alternative Natural Gas Supply Pipeline Routes

Because high-pressure natural gas is available onsite no other alternatives are deemed feasible for consideration.

9.8.2 Electrical Transmission System Alternatives

The preferred transmission alternative is to connect with both the on-site 60-kV system at the Humboldt Bay Power Plant Substation and the on-site 115-kV transmission line. There is no other feasible alternative.

9.8.3 Water Supply Alternatives

Because it employs a closed-loop, air-radiator cooling system, the HBRP will use very little water for cooling (See Chapter 7, Water Supply). Alternatives considered included potable water from the Humboldt Community Services District (HSCD), and water from PG&E's on-site well. PG&E's well water will be used as raw water for plant process and routine makeup to the fire tank. To meet drinking water standards and needs of the emergency fire system, HCSD water will be used.

9.9 Technology Alternatives

The configuration of the HBRP was selected from a wide array of technology alternatives bid into PG&E's 2004 LTRFO. An overview of PG&E's 2004 LTRFO can be found Chapter 1.0 in this AFC. Generation technology alternatives proposed as part of the LTRFO and evaluated included simple-cycle gas turbines, combined-cycle gas turbines, and reciprocating engines. In addition to generating technologies, fuel technology alternatives, nitrogen oxide (NO_x) control alternatives, inlet air cooling alternatives, and heat rejection alternatives were considered.

9.9.1 Generation Technology Alternatives

The Humboldt area is subject to natural gas curtailments, particularly in winter months. As such, the HBRP is required to have liquid fuel back-up to assure local area reliability. Selection of the power generation technology focused on highly reliable, efficient, and environmentally responsible technologies that can utilize the natural gas available from the existing gas transmission system and can easily operate on California Air Resources Board (CARB) diesel as a back-up fuel during times of gas curtailments. Following are discussions of the suitability of such technologies for application to the HBRP.

9.9.1.1 Conventional Boiler and Steam Turbine

This is the technology currently in place at PG&E's Humboldt Bay Power Plant. This technology burns fuel in the furnace of a conventional boiler to create steam. The steam is used to drive a steam turbine-generator, and the steam is then condensed and returned to the boiler. This is an outdated technology that is able to achieve thermal efficiencies up to approximately 36 percent when utilizing natural gas, although efficiencies are somewhat higher when utilizing oil or coal. Because of this low efficiency and large space requirement, the conventional boiler and steam turbine technology was eliminated from consideration.

Moreover, this technology was not proposed by any participants in the LTRFO process, so it was precluded from consideration.

9.9.1.2 Conventional Simple-Cycle Combustion Turbine

Conventional aeroderivative turbine-generator units are able to achieve thermal efficiencies up to approximately 38 percent. The GE LM6000 was considered for the repowering of Humboldt, and one participant proposed this technology as part of the LTRFO process. Through the competitive LTRFO process, a proposal based on the GE LM6000 technology was a finalist, and competed with the Wärtsilä 18VDF50 reciprocating engine technology. The reciprocating engine technology scored a higher valuation in the extensive modeling evaluation completed as part of the LTRFO. The independent evaluator and the Peer Review Group were in agreement with this conclusion. While the LM6000 technology was technically feasible, the poor efficiency of this unit when operating below 50 percent load and the need for very large amounts of water when burning liquid fuels made this technology less desirable than other options. Overall, the reciprocating engines proved to be a superior fit for the HBRP.

9.9.1.3 Conventional Combined-Cycle

This technology integrates combustion turbines and steam turbines to achieve higher efficiencies. The combustion turbine's hot exhaust is passed through a heat recovery steam generator (HRSG) to create steam used to drive a steam turbine-generator. This technology is able to achieve high thermal efficiencies. The combined-cycle alternative, however, requires very large capital cost more appropriate for a baseload facility, a large site, and very large quantities of water for cooling. One of the LTRFO proposals was for a combined-cycle project using an LM6000 combustion turbine-generator. However, due to the high capital costs, the rapid and wide load variations experienced at Humboldt, and the need to be able to quickly respond to rapidly changing loads, the technology did not prove competitive in the evaluation.

9.9.1.4 Kalina Combined-Cycle

This technology is similar to the conventional combined-cycle, except a mixture of ammonia and water is used in place of pure water in the steam cycle. The Kalina cycle could potentially increase combined-cycle thermal efficiencies by several percentage points. However, because this technology is still in the development phase and has not been commercially demonstrated, it was eliminated from consideration. Moreover, it was not proposed as part of the LTRFO, so it could not be considered by PG&E in its evaluation.

9.9.1.5 Advanced Combustion Turbine Engines

There are a number of efforts to enhance the thermal efficiency of combustion turbines by injecting steam or staged firing. These include the steam-injected gas turbine (STIG), the intercooled steam-recuperated gas turbine (ISRGT), the chemically recuperated gas turbine (CRGT), and the humid air turbine (HAT) cycle. The STIG is less efficient than other technologies, uses large amounts of de-ionized water and is only able to achieve thermal efficiencies up to approximately 40 percent. None of the remaining technologies, ISRGT, CRGT, or HAT, is commercially available. Consequently, all of these technologies were

eliminated from consideration. Moreover, none of these technologies were proposed as part of the LTRFO.

9.9.2 Fuel Technology Alternatives

It was a requirement of the LTRFO that the Humboldt units be capable of utilizing liquid fuel (CARB diesel) as a backup to assure local reliability during times of natural gas curtailment in the Humboldt area. Technologies based on primary fuels other than natural gas were eliminated from consideration because they do not meet the project objective of utilizing natural gas available from the existing transmission system. Additional factors rendering alternative fuel technologies unsuitable for the proposed project are as follows:

- No geothermal or hydroelectric resources exist in the area; hence none were proposed as part of the LTRFO process.
- Biomass fuels such as wood waste are utilized in the area at a number of Qualifying Facilities (QFs). Renewable projects were not part of the 2004 LTRFO solicitation, however. In addition, it is unclear whether or not there may be additional biomass fuel available in the project area. PG&E encourages and supports the use of alternative and renewable fuels and is currently seeking renewable resources through the 2006 Renewable Portfolio Standard (RPS) solicitation.
- Solar and wind technologies are being encouraged by PG&E through the numerous RPS solicitations being conducted by PG&E's Electric Procurement Department. These technologies can provide only intermittent generation, depending on natural conditions, and are therefore not capable of meeting the necessary local area reliability criteria for the Humboldt Area. Renewables were not part of the LTRFO solicitation, however, so were not considered for this project.
- Coal and oil technologies emit more air pollutants than technologies utilizing natural gas. None of these technologies were proposed for LTRFO consideration.
- The availability of the natural gas resource provided by PG&E's system, as well as the environmental and operational advantages of natural gas technologies, makes natural gas the logical choice of primary fuel for the proposed project. Liquid fuel will only be used in the event of natural gas curtailments. The HBRP will not have the ability to economically dispatch between natural gas and liquid fuels.

9.9.3 NO_x Control Alternatives

To minimize NO_x emissions from the HBRP, the reciprocating engines will be equipped with post-combustion selective catalytic reduction (SCR) using aqueous ammonia as the reducing agent. The following combustion turbine NO_x control alternatives were considered for the combustion turbine alternative:

- Steam injection (capable of 25 to 42 parts per million [ppm] NO_x)
- Water injection (capable of 25 to 42 ppm NO_x)
- Dry low-NO_x combustors (capable of 15 to 25 ppm NO_x)

Water injection was selected for the combustion turbine alternative because of the need to be able to utilize liquid fuels. Two post-combustion NO_x control alternatives were considered:

- SCR
- $SCONO_x$™

SCR is a proven technology and is used frequently in combined cycle and reciprocating engine applications. Ammonia is injected into the exhaust gas upstream of a catalyst. The ammonia reacts with NO_x in the presence of the catalyst to form nitrogen and water.

$SCONO_x$™ is a new technology and it has been implemented at only one facility: a 25-MW combined-cycle plant. $SCONO_x$™ consists of an oxidation catalyst, which oxidizes carbon monoxide (CO) to carbon dioxide (CO_2) and nitric oxide (NO) to nitrogen dioxide (NO_2). The NO_2 is adsorbed onto the catalyst, and the catalyst is periodically regenerated. Although a potentially promising technology, $SCONO_x$™ has not been commercially demonstrated on a large power plant. There are several technological and commercial issues remaining to be resolved prior to application of this new technology to the class of combustion turbines selected for the proposed project. To the best of PG&E's knowledge, the $SCONO_x$™ system has never been studied for a reciprocating engine application.

The following reducing agent alternatives were considered for use with the SCR system:

- Anhydrous ammonia
- Aqueous ammonia
- Urea

Anhydrous ammonia is used in many combined cycle facilities for NO_x control, but is more hazardous than diluted forms of ammonia. Aqueous ammonia (19-percent ammonia, 81-percent water solution) is proposed for the HBRP because of its safety characteristics and availability within the region.

Several vendors have designed urea-based systems to generate ammonia onsite, thereby eliminating the need to transport and store ammonia. These units are referred to as "Ammonia on Demand" (Environmental Elements Corporation) and "Urea to Ammonia" (EC&C Technologies Incorporated). Only EC&C's Urea to Ammonia (U2A) system is currently available commercially.

The U2A system generates ammonia from solid dry urea. The process starts by dissolving urea in deionized water to produce an aqueous urea solution. Steam is used in the U2A reactor to convert the urea solution into a gaseous mixture of ammonia, carbon dioxide, and water for use in the SCR system. Because the HBRP project will not generate any steam, this design is not technically feasible for the HBRP.

It is also possible to deliver urea to a power plant in liquid form. This liquid urea is spray-injected into the exhaust stream before the SCR catalyst. For the HBRP, this system would require more precise feedback control of the SCR system, however. Since urea injection systems, of necessity, include an additional step of converting the injected urea into ammonia in the exhaust stream, performance of a urea injection system is not as well-controlled as a direct ammonia injection system. Because HBRP will be required to meet very stringent emission control requirements and to demonstrate compliance with emission

limits on a continuous basis, a higher degree of control over the emission control system performance is necessary than can be achieved using urea injection.

In addition, because the urea is injected directly into the exhaust stream in liquid form and is not vaporized before injection, a specific temperature window is required to allow full conversion of the urea into ammonia. During engine startup, it would take longer for these temperatures to be reached and, therefore, direct ammonia injection provides better NOx control during startup than would urea injection. For these reasons, an ammonia-based control system was chosen for the HBRP instead of a urea-based system.

9.9.4 Heat Rejection Alternatives

The HBRP will employ a closed-loop industrial cooling system cooled by circulating water, with heat rejection provided by a network of radiators and fans (very similar to the common automobile or dry cooling). The Wärtsilä standard closed-loop radiator cooling system minimizes water use with only 1.6 gpm of water usage with the plant operating at full load. Wärtsilä does not offer another cooling option with their large reciprocating engines.