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FINAL REPORT

Preconstruction of the Honey Lake Hybrid Power Plant

Contract No: DE-AC07-84ID12477

GeoProducts Corporation
1330 Broadway
Oakland, California
94612

April 30, 1988

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1.0 PROJECT SUMMARY

The work undertaken under this Contract is the prosecution of the preconstruction activities, including preliminary engineering design, well field development, completion of environmental review and prosecution of permits, and the economic and financial analysis of the facility.

The proposed power plant is located in northeastern California in Lassen County, approximately 25 miles east of the town of Susanville. The power plant will use a combination of wood residue and geothermal fluids for power generation. The plant, when fully constructed, will generate a combined net output of approximately 33 megawatts which will be sold to Pacific Gas and Electric Company (PG&E) under existing long-term power sales contracts. Transfer of electricity to the PG&E grid will require construction of a 22-mile transmission line from the power plant to Susanville.

2.0 PROJECT HISTORY

Since 1980, with funding assistance and technical support from the Department of Energy, GeoProducts Corporation has worked to develop a commercial power plant in Lassen County, California that could combine waste wood and low temperature geothermal energy to efficiently produce economic electric energy for sale to Pacific Gas and Electric Company. The successful construction and operation of such a facility would demonstrate the viability of using underutilized natural resources to produce electric energy. Moreover it would effectively lower the "economic threshold" temperature of geothermal fluid for power generation making feasible electric power production from many sites where wood and geothermal resources co-exist.

Since 1981, under several different agreements (DE-AC07-81ID12262 dated April 14, 1981 and DE-AC07-84ID12477 dated January 4, 1984) DOE provided support to this effort. Based on interim results including geothermal temperature, wood waste availability and cost, facility capital and operating costs, environmental regulations, and capital markets. the Honey Lake Project gradually evolved from its various preliminary designs as set forth in the report dated March 1982 from IECO and Morrison & Knudsen into a project as more completely described in Section 3.0. A summary of DOE's involvement in the project and certain major milestones are set forth in Tables 2-1 and 2-2.

During 1985, GeoProducts held discussions on the Honey Lake Project with many potential lenders and equity participants. GeoProducts was assisted in this effort by its financial advisor, Commercial Union Capital Corporation. Potential partners and lenders were unwilling to provide the necessary financial support absent a firm construction price and performance guarantees on the binary design.

In February 1986, Requests for Proposals were issued by Commercial Union Capital on behalf of GeoProducts for the fixed price turnkey construction and operation and maintenance of the Honey Lake project based on the DEC design. In April 1986, an RFP for joint venture participation was issued. Only two companies responded positively to these RFP's. Both respondents rejected participation in the isobutane system. The isobutane system was viewed as unfamiliar and unproven and therefore less predictable. Based on the premarketing discussions, responses to the formal RFP, and the perceived environmental risk associated with both the binary cycle and the attendant

Table 2-1

Honey Lake Project
Major Project Milestones

Date	Milestone
-----	-----
09/80	User-Coupled Proposal submitted to DOE-ID Wood dehydration/combustion ancillary geo- thermal uses
04/81	UCCDP Contract Award
Summer 1981	Drill WEN-1 Rework and test through Spring 1982
12/81	Morrison/Knudsen-International Engineering supple- mentary engineering Developed in view of WEN-1 temperature engineering report on binary system and geothermal ancillary uses
03/82	Morrison-Knudsen/International Engineering Engineering and Economic Study Report
06/82	Project Summary Report
01/83	Preconstruction Proposal to DOE Purpose to complete resource definition engineering, and permitting tasks in order to attract financing. Wood geothermal cycle supplying back pressure steam to binary cycle
07/83	Management Plan for Preconstruction work
01/84	Preconstruction Contract (DE-AC07-84ID12477 awarded
04/84	Drill WEN-2
07/84	Letter regarding DEC Services Agreement signed To provide Project Management, Engineering Procurement, Construction Administration Accounting, and Pre-Operation Services for the Honey Lake Power Plant

10/84 DOE letter regarding availability of geothermal resource

11/84 Title I Engineering Design Report issued

12/84 Review Meeting with DOE
WEN-2 and Phase I work

03/85 Revised Statement of Work
SOW revised to address DOE concerns regarding availability of private financing

07/85 Modification #1
Repayment provision

08/85 Revised Milestone Payment Schedule for Preconstruction Work

10/85 DOE approved subcontract with DEC

11/85 Drill WEN-3

01/86 Project Financial Advisor
GeoProducts retains Commercial Union Capital Corporation as project financial advisor

02/86 DEC services agreement executed

02/86 RFP for Construction and O&M of Honey Lake Project Released by CU Capital Corporation based on DEC design

03/86 Meeting on DOE concerns
Preconstruction work won't attract financing

04/86 RFP for Honey Lake joint venture

5-9/86 Responses to Honey Lake RFP received and evaluated

10/86 Meeting with DEC
DEC unwilling to provide guarantees for, or be equity participant in Honey Lake Plant. Title and materials services only.

12/86 GeoProducts - Zurn/NEPCO development agreement signed.

09/29/87 Final Environmental Impact Report

4/15/89 Notice to proceed issued

Table 2-2

Honey Lake Power Plant

Contract Milestones

Contract No. DE-AC07-84ID1247

Milestone -----	Description -----	Date Complete -----
1.	Submittal of an acceptable Title I Engineering Design Report	11/12/8
2.	Submittal of an acceptable Economic Feasibility Study	11/21/8
3.	Submittal of a report on permitting and licensing including requirements and milestones	11/12/8
4.	Submittal of the Project Review Meeting Summary Evaluation and Recommendation	12/11/8
5.	a. Submittal of draft interim, Engineering Design report	8/05/8
	b. Submittal of acceptable Title II, Engineering Design Report	
6.	Submittal of acceptable Drilling Bid Specifications; approval of drilling subcontracts, site preparation	9/24/8
7.	a. Drilling Contractor mobilization	10/28/8
	b. Completion of drilling and logging to 2500 ft. and submission of deliverables related thereto	12/02/8
	c. Completion of drilling to TD and submission of all deliverables associated with drilling	1/11/8

8.	a.	Well Test Plan and approval of Well Testing Equipment Sub-contracts	3/11/8
	b.	Completion of well testing	1/24/8
9.		Submittal of an acceptable well interference and reservoir test report	1/24/8
10.	a.	Submittal of all required construction permit applications	7/14/8
	b.	All permit and licenses obtained and either a negative declaration or an environmental document suitable to local state, and DOE authorities	10/16/8
11.	a.	Submittal of draft wood fuel supply contracts	9/18/8
	b.	Submittal of power interconnect and transmission agreements	10/16/8
12.		Submittal of final report on plant operability	7/13/8

higher use of geothermal fluid, it was apparent that the binary cycle of the facility would have to be developed under an ownership structure separate from the wood-geothermal cycle.

Additionally, concerns in connection with the use of geothermal fluid under the Safe Drinking Water and Toxic Enforcement Act of 1986 (California Proposition 65), and the requirement that the Project inject all geothermal fluid into Wen-1 raise serious question of whether the binary system will ever be constructed.

In March of 1988, financing for the construction and long-term financing for the wood geothermal portion of the project was obtained from Security Pacific National Bank. Construction commenced on April 15, 1988 and initial power deliveries are scheduled to commence in September, 1989.

3.0 PROJECT DESCRIPTION

Project Location

The project is located in the northern portion of the Honey Lake Valley of Lassen County (Figure 3-1). The site is approximately 2 miles northwest of the town of Wendel and approximately 23 miles east of the City of Susanville. The site is on the north side of Wendel Road, at the intersection with Viewland Road, in the southwest quarter of Section 14, Township 29N, Range 15E. Access to the site is via Wendel Road, connecting the town of Wendel to U.S. Route 395.

The power plant will occupy approximately 4 acres within an area designated for geothermal resource development by Lassen County. The Skedaddle Mountains are to the northeast, Shaffer Mountain to the northwest, and Honey Lake lies approximately 2 miles to the south.

The site consists of lake bed sediments between Honey Lake and the Shaffer and Skedaddle Mountains. The area is nearly level, sloping at about 40 feet per mile to the south. Site elevation is approximately 4,025 feet above mean sea level. Vegetation at the site consists primarily of sagebrush, greasewood, and saltgrass.

Project Characteristics

Electricity will be generated from two power cycles: a wood-geothermal cycle and a binary cycle.

The overall plant will have the following components:

- Power generation cycles
- Wood-burning power cycle
- Geothermal power cycle
- Fuel supply and delivery processes
- Water supply, treatment, cooling, and discharge
- Fire protection systems
- Power transmission lines

The power plant site, geothermal well locations, and associated geothermal pipeline, transmission line, and fluid discharge routes are shown in Figure 3-2. The proposed site plan showing major power plant facilities and components is presented in Figure 3-3.

Figure 3-1. Project Location

Figure 3-2. Project Components

The project will have associated off-site wood fuel procurement and waste disposal components. These support service operations will be conducted by private contractors and will be separate from the operation of the power plant.

Wood-Burning Power Cycle

The wood-burning power cycle will employ a conventional wood-fired boiler to generate high-pressure steam. This steam will drive a turbine generator capable of producing approximately 34.5 Mw of electricity. A mechanically induced draft evaporative cooling tower will be used to cool working fluids.

Wood fuel will be mechanically fed to a conventional wood-fired traveling grate of a pinhole grate steam boiler. Preheated air for fuel combustion, supplied by forced-draft fans, would enter the furnace both above and below the grate. Boiler feedwater would also be preheated, first by one or more feedwater heaters using extraction steam from the turbine, followed by an economizer, which uses flue gas heat.

Both the wood-fired traveling grate and pinhole grate steam boiler can provide 300,000 pounds per hour of superheated steam (950 degrees F, 1,280 pounds per square inch). Superheated steam from the boiler will drive the turbine generator, producing a gross electrical output of approximately 34.5 Mw at the generator terminals. Boiler steam production, and in turn electric power generation, will be regulated in response to steam demand by means of an automatic control system.

Waste materials generated from the wood burning process include flue gases and wood ash residue. For pollution control, flue gases will pass through a multiple-cyclone type of mechanical dust collector, which will remove solids from the gas stream. An induced draft fan (approximately 1500 Hp) will then exhaust the flue gas through an electrostatic precipitator for additional emissions control and out an emissions stack (approximately 10 feet in diameter and 135 feet high). Bottom ash from the boiler grate and fly ash from the dust collector and precipitator will be collected and conveyed to an ash/water mixer. After mixing with water, ash will be discharged to a truck or container. The ash will then be transported by truck for off-site disposal either as a commercial fertilizer or, if not usable, as a solid waste.

Up to 550 gallons per minute of geothermal fluids will be used to preheat boiler feedwater in the wood-burning cycle. If found in the final design stage to be economically feasible, geothermal energy also could be used for wood fuel drying, or to provide preheating for the combustion air.

Geothermal Production Cycle

Unlike the wood-burning process, which will rely on steam generation to produce electricity, the geothermal process will generate electricity by using geothermal fluid to heat a secondary fluid (working fluid). This fluid will be either isopropane or isobutane. The working fluid, which vaporizes at a lower temperature than water, will provide the force necessary to drive a turbine generator with a capability of producing approximately 4 megawatts of electric power. A mechanically induced draft evaporator cooling tower will be used to cool working fluids.

The geothermal power production cycle will begin with the heating of working fluid. The working fluid will be pumped through heat exchangers where it will be heated to its boiling temperature by geothermal fluids from the project wells. Extraction steam from the wood-burning cycle's turbine will be condensed in a heat exchanger and used to further heat the working fluid. Once fully heated, the vaporized working fluid will be piped to a hydrocarbon expander (the turbine), where it will expand and turn the turbine. The turbine will be connected to a generator to produce electricity. The vaporized working fluid will then be transferred to a condenser, cooled by water from the cooling tower, and returned to the geothermal heat exchangers as a liquid to repeat the process.

The system will require approximately 42,000 pounds of working fluid operating in a closed loop. Initially this material will be delivered and pumped into the system by a delivery truck. During scheduled cleaning operations, the fluid will be removed from the system and stored on the site. No fluid will be stored during normal operation. A backup flare system will be installed to burn any working fluid vapors that may accidentally escape through system leaks or during fire or overpressure in the system.

Fuel Supply and Delivery

Wood Fuel

Wood fuels will be obtained from ongoing forestry operations within a 40- to 60-mile radius of the power plant. Though some fuel could be obtained from sawmill residues and some from federal (public) forest lands, most is expected to come from private forest lands under exclusive contracts with the Project. All wood fuel will be procured and delivered to the plant by trucks owned and operated by independent contractors.

Approximately 330,000 to 350,000 tons (wet weight) of wood fuel will be required annually to operate the wood-burning cycle, assuming an average fuel moisture content of 35 percent. Specific types of wood fuel to be consumed include shredded and/or chipped logging waste (slash), much of which is currently open-field burned, unmerchantable timber (cull logs), and precommercial thinnings.

Shredded and/or chipped wood fuel (no greater than 4-inch nominal size) would be trucked to the plant's wood fuel processing facility for storage and eventual use. The on-site wood fuel processing facility will consist of one truck scale and two truck dumpers for unloading field-shredded fuel; a sizing facility for removing tramp metal, screening, and further shredding or chipping of fuel material to a 3-inch-minus size; and facilities to transport fuel to a main storage pile, reclaim fuel from the pile, deliver fuel to the power plant fuel hoppers, and return excess fuel to storage.

Supplementary fuel gas will be stored on site for firing the wood-burning boiler for boiler startup after a plant shutdown. A 5,000-gallon diesel storage tank, in a diked containment area, will provide fuel for site mobile equipment and emergency refueling of wood fuel supply trucks.

Geothermal Fluid

Geothermal fluids will be pumped from one of three existing wells (WEN-1, WEN-2, and WEN-3) in the project area. Two of the wells, WEN-1 and WEN-3, are on the GeoProducts' property east of the plant site. WEN-2 is on BLM mineral-reserved lands, to which GeoProducts has

secured development rights.

As mentioned previously, the probability is that injection of the spent geothermal fluid will be required. Under this scenario WEN-2 will be produced and WEN-1 used as an injection well. WEN-3 will be held in reserve as a production/injection well.

Geothermal fluids will be pumped to the plant in insulated steel pipelines, at 45 pounds per square inch pressure, using geothermal well pumps rated at 1,200 to 1,800 gallons per minute. Pipelines will consist of surface-installed 8- to 14-inch grade A-53 line pipe, anchored with mid-span supports (sleepers) approximately every 30 feet. The pipe will be 2 feet above grade. Expansion loops will be incorporated between the anchors. Approximately 5,600 feet of 8-inch, 1,630 feet of 12-inch, and 620 feet of 14-inch pipe will be used in the geothermal delivery system.

Pipelines will be insulated with calcium silicate or equivalent to minimize temperature losses. Fluid temperatures of 243 degrees F will be expected at the plant site.

Water Supply, Treatment, and Cooling

Water for steam generation, cooling, and other plant operational activities (e.g., plant process water) will be obtained from existing geothermal wells and from a fresh water well (1,000 gallon per minute capacity) to be established in the project vicinity. These waters will be collected, used in various plant processes, and ultimately discharged to Honey Lake, if permitted. The expected fresh water demand of the power plant will be approximately 910 to 970 gallons per minute, and the expected demand for geothermal fluid will be approximately 2,750 to 3,330 gallons per minute.

Potable water will be brought to the site by truck and stored in a 15,000-gallon storage tank. Fire control and cooling water requirements will be provided by a one-million-gallon lined storage pond. Water will be supplied to the storage pond by the fresh water well to be established in the project vicinity.

The four principal components of the water system are (1) geothermal processes, (2) cooling and condensate loops, (3) boiler feed water, and (4) wastewater treatment facilities.

Geothermal fluid is used primarily in the geothermal cycle, but also could be used, to a lesser extent, in the wood-burning cycle as described above.

Cooling and condensate loops will be used in support of electrical production for both cycles. A counter-flow evaporative cooling tower with induced draft will be installed for each production cycle.

Water treatment facilities will be provided to condition cooling tower makeup water, boiler makeup water and process condensate prior to its use or reuse. Fresh water will be used for boiler and cooling tower makeup. Prior to its use in plant processes, the water will be treated using a two-stage two-train demineralizer and a deaerator. Boiler makeup water will be further conditioned by addition of antioxidants, organic amines, and coordinated phosphate. Chemical additions to the cooling tower makeup will include scale inhibitors, corrosion inhibitor and dispersant, and chlorine. Demineralizer regeneration will use sulfuric acid and caustic soda solutions to remove accumulated minerals from the demineralizer media. This waste will be routed to a neutralization tank where the effluent pH will be adjusted by addition of sulfuric acid or caustic soda prior to discharge.

Wastewater flows, including cooling tower blowdown, boiler blowdown, neutralized demineralizer regeneration waste, bearing cooling water, and wet ash conveyor blowdown, will be routed to a 15,000-gallon capacity wastewater sump below ground level. From the sump, wastewater will be either (a) pumped via pipeline to a disposal well where it will be injected along with the geothermal effluent or (b) pumped to an open disposal channel where it will mix with the plant geothermal effluent. Expected wastewater flows will be approximately 330 gallons per minute from cooling tower blowdown, boiler blowdown, and demineralizer regeneration. At full operation, and assuming no injection requirement, approximately 2,750 and 3,300 gallons per minute of geothermal fluids will be discharged at a temperature of about 140 degrees F.

On-site sanitary waste from plant facilities will be discharged to a 1500-gallon septic tank and leachfield system.

Fire Protection Systems

The potential for wood fuel pile fires and fire in critical plant areas will be monitored from the power plant control room by means of televideo systems. Eight fire hydrants with hose houses will be spaced throughout the site, providing coverage of the fuel piles and nearby structures. The one-million-gallon capacity reservoir will supply water for the fire system. One electric and one diesel pump will each provide 1,000 gallons per minute flow capacity at 100 pounds per square inch to the fire hydrant system. Hydrants and the associated water supply pipelines and fixtures will be capable of delivering 500 gallons per minute at any hydrant location.

The wood fuel piles will be at least 60 feet away from any structure. Equipment will be readily available for digging into the spreading the wood fuel piles.

Transmission Line

Electricity generated by the proposed power plant will be sold to PG&E. The load, conductor, and transformer capacity of the existing 34.5-KV transmission line near the project site will be inadequate to handle the potential electrical output of the plant. Therefore, a 22-mile 60-KV transmission line will be constructed to carry power from the plant to an existing substation on the west side of Susanville. The transmission line will be constructed along the Southern Pacific Santa Fe Railroad right-of-way from south of the plant site to Susanville. The line will connect with a CP National substation in Susanville and will be wheeled to Westwood for purchase by PG&E.

Transmission line components will consist of wood power poles with composite epoxy line post insulators set on 200 to 300-foot centers, terminating with steel A-frame deadends at both the plant and Susanville substation.

Project Economics

The total capital cost of the project is estimated to be \$71,160,000 including capitalized interest during construction, fees, interconnection costs, development expenses and taxes. The addition of a 4 MWe binary cycle would add approximately \$8 million in capital cost.

Revenue generated by the Project will be derived from energy payments based on kwhr production and capacity payments based on the total net plant capacity made available to PG&E. The facility is designed to operate at a 90% availability factor (inclusive of scheduled and forced outages) and generate 236,520,000 kwhr annually.

The 30-year power purchase agreement with PG&E (Standard Offer #4) provides for stipulated energy prices for the first 10 years beginning at \$.0734/kwhr in 1989 and escalating to \$.1314/kwhr in 1997. Thereafter the energy prices paid for the facility output will equal PG&E's actual "avoided cost". Capacity payments are currently \$20/kwhr for "as-delivered" and \$156/kw for firm capacity.

The facility will employ approximately 33 persons full-time on-site and will generate an additional 40-60 jobs in the wood fuel harvest, collection and delivery operations for a total annual payroll of \$2 million. Additional property tax revenues are estimated to total \$600,000.

4.0 SIGNIFICANT OBSERVATIONS AND CONCLUSIONS

Through intensive local contacts the project has enjoyed a high degree of user and community support. This support is manifest in part by additional geothermal power development in the Wendel-Amedee KGRA (1 MW operational; 1.5 MW under construction), and the designation by Lassen County of the general project area a geothermal development area.

In spite of considerable favorable data on the geothermal resource generated through the drilling and testing of three deep production wells the financial markets continue to react cautiously to the long term productivity of the resource. This concern has been addressed by reducing the amount of geothermal fluid useage, requiring injection of the spent geothermal fluid, and "reserving" Wen-3.

Fuel risk (geothermal and wood) was viewed as a significant issue by all aspects of the financial community. To this end the Project was successful in negotiating and obtaining agreement for the long term supply of wood fuel. These agreements, believed to be the first of their kind in California, with private landowners, provide the Project with fuel supply and price stability for between 7 and 10 years.

In the current configuration of one production well, one injection well and one well in reserve, the use of geothermal fluid (250 degrees/550 gpm) eliminates the need for approximately 2 tons of wood fuel per hour (oven dry basis) or 7% of the wood fuel requirement without the geothermal input. At an average cost of \$35 per ton (1989) this savings equates to a first year savings of approximately \$550,000 (gross). This annual savings is achieved at a capital cost approaching \$2.9 million dollars (excluding Wen-3).

The drilling and testing of WEN-3 represented a significant portion of the project budget and work effort. WEN-3 was completed at a depth of 6441' on January 11, 1986. WEN-3 the encountered a geologic section similar to WEN-1 however, the bedrock is substantially less fractured due to a greater distance from the Wendel Fault. No drilling problems were encountered except for minor lost circulation problems in the granite. The primary production zone was encountered between 5,100' and 5,400' in slightly altered and sheared granodiorite. Drilling continued in hopes of hitting more productive zones, however, as experienced in WEN-1, the section below 5,400' was not fractured.

Short term artesian tests were performed at the conclusion of drilling and limited productivity was evident. WEN-3 is capable of sustaining 180 gpm of artesian flow. Subsequent pump tests indicate Wen-3 has a transmissivity of approximately 10% of WEN-1.

The permitting and licensing of a facility of the size and complexity of the Honey Lake Project is a major undertaking. While the California Environmental Quality Act (CEQA) provides the framework for this activity, which provides an equitable forum for both the project developer and opponent to present their views, there is much room for dispute over the project design, construction and operation. Based on the potentially controversial nature of the project and due to problems encountered by Lassen County in other wood-fired projects, the Honey Lake Project was required to develop an Environmental Impact Report to obtain a Land Use Permit. This process, while providing a thorough review of the project and a discussion and resource document to be utilized by the County in determining the acceptability of the project, is costly and time consuming. Direct out-of-pocket cost by GeoProducts and affiliates during this 1 year effort approached \$500,000. In addition to the Land Use Permit, the local Air Pollution Control District requires an Authority to Construct and the Environmental Protection Agency required a Prevention of Significant Deterioration Permit, both of which require substantial ambient air quality modeling and monitoring efforts.

In a related area, the passage of the Safe Water Drinking and Toxic Enforcement Act in 1986 (Proposition 65) and its recent (and ongoing) implementation raises serious concerns about the use of geothermal in California. The act prohibits the discharge of fluid which contains a "listed chemical" in significant amounts when such discharge has the potential of contacting a drinking water source. The geothermal resource has trace amounts of the listed chemicals arsenic, boron, and molybdenum. While by most standards the geothermal resources in the project area are not considered drinking water sources, this has not yet been formally defined. The confusion over Proposition 65 notwithstanding, the original plan of surface discharge of the geothermal effluent was determined to be incompatible with the planned use of Honey Lake and the lake shore margin which necessitated injection of the geothermal effluent.

The project's electrical output is wheeled through CE National, a local non-generating wholesaler of electricity and is sold to Pacific Gas and Electric Company at Westwood,

California. The project obtained a Standard Offer #4 from PGandE providing for the sale of power for 30 years. Pursuant to the terms of the contract, the Project was required to pay the costs of interconnection into the PGandE system. Generally under California PUC regulations governing Qualified Facilities, if there is a systemwide benefit as a result of a QF's interconnection, the PGandE is to pay the costs. Alternately, if no system benefits accrue the QF pays.

GeoProducts and its Partners asserted that the system benefits of the Honey Lake Project were substantial. These benefits included system stability, the potential of adding a second circuit into a remote mountainous region and enhanced frequency control. PGandE disagreed and refused to sign the Special Facilities Agreement until the project agreed to pay the \$3.2 million cost of interconnection. The loss of the Special Facilities Agreement could have eliminated the Project's ability to sell power to PGandE.

An additional complication in this area was created by the fact that during negotiation of the transmission agreement with CP National the Susanville service area was sold to a newly formed local municipal utility district.

While significant, much of the foregoing is not unexpected in the area of project development and finance. The lower than expected temperature of the geothermal resource coupled with the unwillingness of the equity and debt markets to accept the risk associated with a seemingly complex combination of technologies and resources required fundamental shifts in design and approach namely: reduction of geothermal useage, separation of ownership, construction, and operation between wood/geothermal and binary cycles, and the change from a discreet design-bid-build approach to one of a turnkey design/build contract incorporating appropriate cost and performance warranties.

5.0 PROJECT COSTS, SCHEDULES AND ORGANIZATION

Project Costs

The total expenditures for the period January 1984 to March 31, 1988 total approximately \$3,209,962 as shown in Table 5-1.

Table 5-1

Project Expenditures

January 1984 to March 1988

	Total	DOE	GPC(1)
Environmental (3, 10a,b)	\$ 480,686	188,000	292,686
Geothermal (6,7a,b,c,8,9)	1,246,011	1,200,000	46,011
Engineering (1,4,5a,b)	747,523	500,000	
Wood Fuel (11a)	185,117	45,000	140,117
Transmission & Power Sales (11b)	255,851	17,000	238,851
Economic and Financing (2)	275,802	50,000	225,802
Site and Easement	18,972	--	18,972
Final Report (12)	200,000	200,000	
	-----	-----	-----
TOTAL	\$3,209,962	\$2,200,000	\$959,962

- (1) An additional \$3.3 million in external costs were incurred by GPC and its affiliates in arranging the project financing and completion of the development work associated therewith.

Project Schedule

Under the terms of the engineering and construction agreement with NEPCO the project is scheduled for completion 18 months from the date of Notice to Proceed. Notice to proceed was issued on April 15, 1988.

Project Organization

The project team (Figure 5-2) consisted of GeoProducts; Commercial Union Capital Corporation; Gertsh, Juncal and Associates and Dow Engineering and Construction.

Figure 5-1

Figure 5-2
Project Organization Chart

6.0 WORK PACKAGES

Environmental [Legal, Institutional]

The objective of this work package as defined in the Contract was to a) develop an initial study for environmental compliance for submission to the Lassen County Planning Department, and b) to complete permitting as required. The initial study for the project was prepared and submitted to Lassen County on October 14, 1986. On the basis of this document as revised at the request of Lassen County, Harding Lawson Associates (Novato) was retained to develop a complete Environmental Impact Report. The Final Environmental Impact Report (1) was issued on September 29, 1987. The Conditional Use Permit was issued on December 16, 1987.

All permits and licences necessary for the construction of the facility have been obtained. A selected list of the permits and licences, the date filed and the date obtained is set forth in Table 6-1.

Geothermal Resource Development

The purpose of this work package was to drill and test a third production well in the resource area (WEN-3) and to test and evaluate the reservoir. WEN-3 was completed on January 12, 1986 at a depth of 6,440 feet. Its profile is shown in Figure 6-1. Previously, GeoProducts had successfully drilled and tested three deep geothermal wells in the project area. WEN-1 is in Section 13 and was completed to a depth of 5,837'. The well construction profile is shown in Figure 6-2. Well WEN-2 was drilled in Section 23 and completed to a depth of 5,030'. The well construction profile of WEN-2 is shown in Figure 6-3. The construction of these wells incorporates double casing protection through the top 300', ensuring certain protection of the fresh water aquifer zone.

The water chemistry analyses of the wells are provided in Table 6-2. As the analyses indicate, the well fluids are uncharacteristically clean for hot geothermal fluids and approximate the chemical profile of the nearby Wendel Hot Springs. Calcium carbonate solids may have a slight tendency to form at the inlet temperature (243 degrees F), but will be below saturation as the water temperature drops in the heat exchanger. Neither calcium carbonate scale nor silica scale are expected to be a problem.

Table 6-1

Selected Licenses, Permits and Applications

1. Prevention of Significant Deterioration Permit issued by the U.S. Environmental Protection Agency to the Company on March 11, 1988.
2. Application for Plan of Operations/Sundry Notice regarding WEN-2, to be issued by the U.S. Department of the Interior Bureau of Land Management, submitted on June 6, 1986 by GeoProducts Corporation.
3. Application for Waste Discharge Requirements (regarding water and ash disposal) to be issued by the Lahontan Regional Water Quality Control Board, submitted on January 12, 1988 by GeoProducts Corporation and Addendum filed on March 4, 1988.
4. Application for National Pollutant Discharge Elimination System Permit to be issued by the Lahontan Regional Water Quality Control Board, submitted on January 12, 1988 by GeoProducts Corporation.
5. Application and Permit for Authority to Construct issued to Zurn-NEPCO and GeoProducts by the Lassen County Air Pollution Control District, on March 1, 1988.
6. Final Environmental Impact Report, certified by the Lassen County Planning Commission on October 7, 1987, and dated September 29, 1987.
8. Minor Subdivision Approval issued to GeoProducts Corporation on December 14, 1987 by the Lassen County Planning Commission.
9. Application and Data to Support Application for conversion to Injection of Geothermal Well WEN-1, Wendel-Amedee KGRA Lassen County, submitted by GeoProducts and the Company to the California Division of Oil and Gas on March 4, 1988.

Figure 6-1. WEN-3 Well Construction Profile

DEPTH IN FEET
(Surface Measurements)

CASING
SIZE

Figure 6-2. WEN-1 Well Construction Profile

DEPTH IN FEET
(Surface Measurement)

CASING SIZE

Figure 6-3. WEN-2 Well Construction Profile

Table 6-2

Chemistry of WEN-1, WEN-2, WEN-3 and Wendel Hot Springs

Symbol	Name	Concentrations (ppm)			
		WEN-1	WEN-2	WEN-3	Wendel Hot Springs
Na	Sodium	306	301	320	260
K	Potassium	16	9		8
Ca	Calcium	37	23	32	20
Mg	Magnesium	<.5	<.49	0.02	0.5
Fe	Iron	0.03	<.02	0.09	0.02
SiO ₂		96	100		131
Ba	Barium	<.625	<.61	0.1	3.9
Cr	Chromium	<.05	<.05	0.005	0.05
Mn	Manganese	<.25	<.24	<.005	0.25
Cu	Copper	<.063	<.06	<.04	0.06
Pb	Lead	<.25	<.024	0.03	0.25
Zn	Zinc	<.125	<.125	<.04	0.12
Cd	Cadmium	<.063	<.06	<.001	0.06
Ag	Silver	<.05	<.05	0.01	0.05
As	Arsenic	<.625	<.61	0.45	0.62
Sb	Antimony	<.750	<.73		0.75
B	Boron	8.4	4.2	4.4	6
SO ₄	Sulfate	357	370	390	326
Cl	Chloride	265	216	190	180
F	Fluoride	6.1	4.6	4.8	4.4
HCO ₃	Bicarbonate	47	?	70	60
CO ₃	Carbonate		2	40	
OH	Hydroxide			None	
	Nitrate Nitrogen			<0.1	
NO ₃	Nitrate			<0.4	
Mo	Molybdenum	<1.25	<1.22	0.16	
Se	Selenium			0.005	
Hg	Mercury			0.0002	
Li	Lithium	0.27	0.15		
Sr	Strontium	1.1	0.32		
Al	Aluminum	<.625	<.61		
Ti	Titanium	<.125	<.12		
P	Phosphorus	<.625			
V	Vanadium	<1.25	<1.22		
Co	Cobalt	<.025	<.02		
Ni	Nickel	<.125	<0.12		
Au	Gold	<.01	<.10		
Bi	Bismuth	<2.5	<2.44		
U	Uranium	<6.25	<6.10		
Te	Tellurium	<1.25	<1.22		
Sn	Tin	<.125	<.12		
W	Wolfram (Tungsten)	<.125	<.12		
Be	Beryllium	<.005	<.00		
Zr	Zirconium	<.125	<.12		
La	Lanthanum	<.125	<.12		
Ce	Cerium	<.25	<.24		
Th	Thorium	<2.5	<2.44		
TDS		1250	1042	1290	982
pH		6.8	8.7	8.3	8.8

As part of the overall reservoir analysis, vapor phase and liquid phase analyses were combined and calculated on a weight-to-weight ratio for fluid samples from the wells. The results were as follows:

Table 6-3

Fluid Samples Ratio

He	0.10
H2	0.0015
CH4	0.85
O2	0.010
N2	62
CO2	1.49

Additionally, the low oxygen levels will make oxygen attack of no concern. Trapped gas pockets which may contain some methane will be out of explosive limits because of low oxygen content. Hydrogen levels are below problem concentration also. Carbon dioxide is measured from bicarbonate in the water. At existing pH's, free CO2 is not expected. The dissolved gases do not present any significant materials design or environmental problems. The presence of H2S is not indicated.

In the late spring of 1984, WEN-2 was flow tested for a duration of three weeks. The testing consisted of a three phase step flow and a long term (2 weeks) constant flow (370 gpm) test. The data obtained, when correlated with that obtained during the earlier testing of WEN-1, provides reasonable understanding of the geothermal production regime.

WEN-2 exhibits moderate permeability and productivity. The productivity index exhibits quadratic characteristics; that is, the pressure drawdown is not a linear function of flowrate. At a production rate of 370 gpm, the productivity index is approximately 7 gpm/psi. During the long term flow test, the temperature of the produced fluid reached 245 degrees F, while downhole the temperature reached 251 degrees F. Well shut-in pressure (cold) is approximately 32 psi.

The major purpose of the long term testing was to attempt to locate any boundaries which might be encountered as the well's sphere of influence expanded. The fluids produced

from WEN-2 are derived from a fractured geothermal flow system or "reservoir". The precise extent of this reservoir is not known, although reservoir engineering conducted in 1984 suggests a prodigious source volume with a drainage radius of about 11 miles and the presence of a recharge condition. The engineering report suggested the existence of a source volume sufficient to provide the project requirements for several life times.

In February of 1987 a more extensive well field flow/pump test program involving all three deep wells was conducted. WEN-2 was monitored continuously throughout the approximate 3-month test program, but was not be produced. The detailed analysis and conclusions can be found in Pump Test Analysis and Geothermal System Model dated February 15, 1987, but generally collaborate the findings of the previous test. Data analysis and conclusions to be drawn from the field test program will be assembled by Fall, 1986, and the results will further refine the conclusions of the 1984 reservoir engineering study.

Engineering

In mid-1984, GeoProducts selected Dow Engineering Company to complete preliminary engineering on the project based in part on DEC's experience with both wood fired and geothermal power plants and their interest in providing "financable" price and performance guarantees. In November 1984, Dow Engineering Company released the Report on the Preliminary Engineering Design of the Honey Lake Power Project. Figure 6-4 depicts a schematic of the Honey Lake Power Plant as described in that document.

Due to the unwillingness of the financial market to take the preceived risk of the binary system, the project will be financed and owned in two separate segments.

In the wood-geothermal cycle, shown at the top of Figure 6-5, power would be produced by a turbine generator using steam created in a wood fired boiler. Geothermal fluid will be used to preheat the boiler feedwater. Geothermal energy may also be used to dry wood fuel and to preheat combustion air. This cycle would be designed to generate 30 net megawatts for sale to PG&E, and produce steam that would be sold to the owners of the binary cycle.

Figure 6-4. Initial Process Flow Sheet

P-1001 / P-1002
 BOILER FEED PUMPS
 1" x 1/2" NPT
 400 HP EACH

V-1001
 DEWATERING TANK
 10' x 10' x 10'

E-100
 STEAM CONDENSER
 AND 153 BOLLER
 1" x 1/2" NPT
 100,000 BTU/Hr. HEATED
 42,500 BTU/Hr. COLD

E-210
 LIQUID WASH-OUT
 5' x 15'
 FLESH SEPARATION

P-1 A/B/C
 GEOTHERMAL PUMPS
 2500 GPM
 800 HP EACH

E-200
 150-BUTANE RECONDENSER
 5' x 15' x 15'
 90,000 BTU/Hr. HEATED
 22,000 BTU/Hr. COLD

E-210
 150-BUTANE STEAM CONDENSER
 10' x 50'
 30,000 BTU/Hr. HEATED
 10' x 50'

E-210 A/B
 CONDENSERS
 1" x 1/2" NPT
 815,000 BTU/Hr. HEATED
 84,500 BTU/Hr. COLD

C-1-200
 COOLING TOWER
 60-200 LPM

P-200 A/B/C
 150-BUTANE PUMP
 15,000 GPM EACH
 3000 HP EACH

E-210 A/B
 CONDENSERS
 1" x 1/2" NPT
 815,000 BTU/Hr. HEATED
 84,500 BTU/Hr. COLD

P-300 A/B/C
 COOLING TOWER PUMP
 1" x 1/2" NPT
 315 HP
 350 GPM EACH

P-200 A/B/C
 COOLING TOWER PUMP
 1" x 1/2" NPT
 315 HP
 350 GPM EACH

STREAM NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
TEMP	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
COMPONENTS	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
1	100.0																															
2		100.0																														
3			100.0																													
4				100.0																												
5					100.0																											
6						100.0																										
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31																															100.0	
32																																100.0

NOTES:

015 PSIA STEAM / 50 DEG F COOLING WATER / 10-10 DEG.

10/25/84

DESIGN CRITERIA
 PLANT-40 811
 TOLMAN PLANTS
 DESIGNED BY
 DATE 10-25-84

EDW ENGINEERING COMPANY
 1001
 1001
 MATERIAL & HEAT BALANCE
 HONEY LAKE POWER FAC. 1

The binary cycle would produce additional electrical energy by the heating of isobutane which is routed through a turbine generator. This heating is accomplished first in a geothermal fluid heat exchanger. The isobutane is then heated and further pressurized in a second heat exchanger which receives extraction steam from the wood fired boiler. The output of this portion of the facility with steam would be approximately 4 net megawatts.

Wood Fuel

The plant will consume approximately 212,000 bone dry tons (BDT) of woody biomass fuel annually when it is in full operation. The vicinity map (Figure 6-6) shows the location of the plant and the surrounding environs.

A conservative estimate is that there is a potential to produce nearly 2.2 million BDT of fuel annually within an economic reach of the Wendel location. The Project demand is somewhat less than 10 percent of the total annual fuel supply excluding an existing inventory of fuel in the forest built up from years of timber harvest operations.

The fuel supply plan, adopted by the Project is two-fold (1) to obtain more than an adequate amount of fuel to operate the power plant under long term contracts with landowners and (2) acquire lower cost "spot market" fuels as available.

The result of this strategy is an extremely stable supply base which is independent of supply and price of log and lumber market cycles.

The Project has contract commitments for a minimum of five (5) years for at least 75 percent and potentially over 100 percent of the total annual fuel requirements. The Project anticipates an average fuel cost as \$35 per BDT in 1989, escalating at four percent (4%) per year thereafter. This approximates the cost of inforest harvest in 1989 with only modest improvements in efficiency or ability to contract for less expensive fuels in the future.

More than three-quarters of the contracted fuel has been committed by the three (3) largest local owners of industrial forestland. These three (3) ownerships jointly control approximately one and one-half million acres of northern California forestland. Fruit Growers Supply Company owns approximately 340,000 acres of forestland; Roseburg Lumber Company (Roseburg Resources) owns or

Figure 6-6. Vicinity Map

controls through interrelated companies approximately 650,000 acres of land; and W. M. Beaty & Associates, Inc manages approximately 460,000 acres of land for various long term clients.

The following fuel supply summary pie charts (Figure 6-7 show the relationship of estimated annual production of the various types of fuel within an economic reach of the Project and an estimate of present uses. Without the existence of Project, approximately 50 percent of the fuel available to market potential is not efficiently used nor planned to use at this time (41% + 10% on right hand pie chart). The Project will be demanding about 212,000 BDT per year, or about 10 percent of the fuel competitively available under present conditions.

The total available fuel supply will likely expand over the next several years as demand increases. Thinnings and other inforest sources will become more plentiful as technology advances and fuel markets grow. Mill residues will also increase as lumber producers shift to smaller logs because residues are a much larger percentage of the cubic content of small logs than of logs sawn in area sawmills today. Thus, contrary to intuition, it is likely the development of a biomass fuel demand will, to a certain degree, result in conditions that will favor some retooling in the forest products industry which will in turn make more, not less fuel available in the future.

Power Transmission and Sales

Power Purchase Agreement

The Standard Offer No. 4 Power Purchase Agreement between the Project and PG&E obligates PG&E to purchase the Project's entire power output, up to 30 MW, for 30 years. The Power Purchase Agreement stipulates that energy deliveries must start before March 22, 1990.

The rates to be paid by PG&E for energy delivered by the Project will be determined by formulas set forth in the Power Purchase Agreement. Payments will be made monthly at a rate per kilowatt-hour equal to the sum of: (1) an energy payment rate based upon the time of day and season in which the power is delivered and (2) a capacity payment rate. The formulas for these payments are described in the following paragraphs.

HONEY LAKE POWER

SOURCES OF FUEL

USES OF FUEL

TOTAL 2138 M BDT/YR

Energy Payments

The Project is entitled to a fixed schedule of energy payments under Energy Payment Option 1 of Standard Offer No. 4. Under this option, it will be paid fixed energy prices for output, which vary based upon the time of day and season in which the Project produces power, for the first ten years of Project operation. These energy prices, when initially determined, were based on forecasts of PG&E's avoided costs for the ten-year period. Daily on-peak, partial-peak, off-peak and super-off-peak fixed rates are highest during seasonal Period B (November 1 through April 30) and drop off slightly during Period A (May 1 through October 31). The following table lists the weighted average annualized fixed energy rates provided in the Power Purchase Agreement's Forecasted Energy Price Schedule:

Table 6-4

Power Purchase Agreement's Forecasted Energy Price Schedule

Year	Energy Rate cents/kwh
-----	-----
1989*	7.34
1990	7.84
1991	8.34
1992	9.01
1993	9.75
1994	10.54
1995	11.39
1996	12.24
1997	13.14
1998	13.14
1999*	13.14

*Partial Year

Energy prices after 1998 are not stipulated in the Power Purchase Agreement; however, a December, 1986 ruling by the CPUC stated that the 1997 rate would remain in effect through the tenth year of energy deliveries. After the Project has been in service for ten years, the energy payment will equal PG&E's full short-run avoided costs, which could be less or greater than the fixed price in year ten.

Capacity Payments

The Power Purchase Agreement provides for the delivery of 20 MW to PG&E on a firm capacity basis and the remaining 10 MW on an as-delivered basis. The obligation of PG&E to make firm capacity payments is dependent upon the Project's ability to deliver capacity during PG&E's peak periods (currently June through August). To achieve the full firm capacity payment for each year the Project must be able to deliver at least 80% of the 20 MW's each month during the peak period.

The firm capacity price is based on the Project's firm capacity availability date, which is anticipated to occur in 1989. Pursuant to CPUC orders in October 1986 and December 1986, the firm capacity price schedule in Standard Offer No. 4 has been extended to include availability dates of 1988, 1989 and 1990. The firm capacity price for projects going into service in 1989 is \$184/kw-year.

The Project is entitled to receive a firm capacity performance bonus payment after it has demonstrated a firm capacity factor in excess of 85% during the span of the peak months of June, July and August. The monthly performance bonus payment increases as the firm capacity factor increases from 85% to 100%, with the maximum bonus payment equal to 17.6% of the firm capacity payment.

The remaining 10 MW Project capacity in excess of the 20 MW of firm capacity will be paid for by PG&E on an as-delivered capacity basis. Prices for this as-delivered capacity will be authorized from time to time by the CPUC.

Transmission Agreement

Pursuant to the Transmission Agreement with CP National, all electrical energy and capacity delivered to CP National will be transmitted to PG&E, less a line loss allowance, and not to exceed 34.5 MW. CP National will install the necessary interconnection facilities in Susanville at the cost of the project.

The Transmission Agreement will have an initial term of 30 years, and may be cancelled by CP National thereafter. The Project will pay a wheeling charge of

0.1 cent per kwh of energy delivered. The charge may be increased by CP National upon giving 180-days notice, provided the increase is calculated in accordance with the regulations of FERC concerning such changes. This commitment to provide firm wheeling capacity for the Project is interruptible only in cases where curtailment or reduction is required by CP National to comply with prudent electrical practices.

All transmission agreements are subject to the jurisdiction of FERC which required that the contracts be filed for approval between 60 to 120 days before service is rendered. Approval is generally automatic if no protest is filed, and none is expected.

Economic and Financial

The construction and permanent financing for the Project are based solely on the credit of the Project and HLPC. The financing obligations are non recourse to the Partners and Contractors.

Construction of the Project will be financed with 100% debt financing through a loan syndicated by Security Pacific National Bank. Under the terms of the construction loan, the lender will make progress payments during construction to the Contractor under an agreed-upon schedule.

Upon completion of the Project, the Construction Credit Facility will be refunded from the proceeds of the permanent financing. It is presently contemplated that the permanent financing will be in the form of a 10-year loan and an equity investment by an institutional investor.

The term debt will be supplied by the construction lender by converting the Construction Credit Facility into the term debt upon completion. The term debt will consist of (1) a fixed or floating rate permanent loan in an amount equal to the Project's total capital cost less the equity investment made by the institutional investor and (2) a working capital loan to provide working capital financing during the Project's first three years of operation.

7.0 PROJECT RISK ANALYSIS

This section summarizes the risks associated with the Project and the protection that was designed to minimize the possibility of occurrence.

Risks	Protection
<u>Design Completion Risks</u>	
Project Cost Overruns:	Fixed-price and fixed-schedule construction contract with Contractor. Contractor to bear portion of cost overruns. Interest rate risk is mitigated by the relatively short construction period (18 months).
Completion Delay:	In the event Completion is delayed beyond the Scheduled Completion date, Contractor to pay, as liquidated damages, up to 10% of the Base Construction Price to cover any shortfalls in making interest, principal or lease payments, and will loan an additional 10% to the Project thereafter. If Contractor fails to use its best efforts to achieve Completion, Project will have the right to replace Contractor and have the Project completed at the expense of Contractor.
Non-Conformance with Performance Standards:	In the event the results of the Final Performance Tests determine that the Project operates at less than 100%, but greater than 90%, of Design Net Output, Contractor has the option, in lieu of achieving Completion, to reduce the Base Construction Price on a \$ per Kw basis.

Warranties and Guarantees:

Contractor to warrant equipment, materials and workmanship for one year following Completion. The boiler and turbine-generator equipment will be warranted for two years from date of Substantial Completion.

Operation

Wood Fuel Consumption:

Contractor is required to construct the Project to meet guaranteed fuel use specifications.

Availability of
Geothermal Resource:

Engineering studies indicate that each of the three existing geothermal wells alone has more resource available than will be required by the Project over its useful life.

Technical Performance:

A 20 year O&M Agreement provides for a five year availability guarantee whereby O&M Contractors will loan up to \$4.34 million to make up any shortfall in covering all non-fee expenses and financing costs (after depletion of the Reserve Fund) in the event the Project fails to operate an 80% availability factor and such failure is not a result of force majeure or a shortage of wood fuel supply.

Operation and
Maintenance Costs:

Operation and maintenance expenses will be budgeted on an annual basis. A reserve fund will be established to assure adequate funds to cover anticipated and emergency major maintenance expenses outside of the scope of the annual budget.

Marketing Risks

Electricity Sales:

PG&E has contracted under a

Standard Offer No. 4 Agreement to purchase all electrical power generated by the Project for 30 years.

The Project has elected Curtailment Option A under the Contract which may be invoked by PG&E at times of excessive river runoff (hydrospill) which occur simultaneously with minimum system load. To date, this curtailment option has not been invoked by PG&E under any contract subject to this option.

CP National will commit to wheel all power delivered by the Project, subject to line loss and not to exceed 34.5 Mw. CP National may refuse to accept power only at times of system maintenance or emergencies, which are expected by HLPC to occur infrequently.

Electricity Revenues:

Energy rates are fixed for the first ten years of Project operation as per the PG&E Standard Offer No. 4. In subsequent years, PG&E will purchase energy at a rate equal to its reported avoided costs, as authorized from time-to-time by the CPUC.

PG&E will be required to make firm capacity payments for the fixed capacity component of 20 Mw. The firm capacity payment can only be reduced by PG&E if the Project fails to make available the contracted amount during on-peak periods. The firm capacity bonus payment of up to 17.6% of the base firm capacity payments commences after the Project has proven its ability to deliver 85% of its firm capacity commitment during each of PG&E's peak months. In addition, PG&E will pay for the remaining 10 Mw of capacity on an as-delivered capacity basis.

The firm capacity payment rate of \$156.4/kw-year assumed that the Project is classified as "remote" with a loss adjustment factor of 0.85. If the Project is classified as "nonremote", the loss adjustment factor used to calculate both firm and as-delivered capacity payments would be increased significantly to 0.989 as compared to the assumed 0.85. If classified as "remote", the Project's actual loss adjustment factor could vary from a low of 0.795 to above 0.90, depending on the outcome of negotiations with PG&E.

If the Project has a firm capacity availability date in 1990, the firm capacity price would increase to \$196/kw-year from the assumed \$184/kw-year. The price of \$196/kw-year would also be reduced by the loss adjustment factor.

Regulatory Risks

All environmental risks have been eliminated or reduced through a combination of design changes and/or operating approach. Specific areas of risk containment include:

- a requirement that all geothermal fluid be injected.
- a requirement that all ash be determined to be "non-hazardous" by California Department of Health Services before disposal in Class III landfill.
- requirement that the project to install ammonia injection system for NOX control.
- separate operating company established to contain Proposition 65 risk.

8.0 REFERENCES

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