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Hawaii Geothermal Project

OVERVIEW OF STATUS, DEVELOPMENT APPROACH AND FINANCIAL FEASIBILITY ASSESSMENT

DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT
STATE OF HAWAII

HAWAII GEOTHERMAL PROJECT

Overview of Status, Development Approach and Financial Feasibility Assessment

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HAWAIIAN GEOTHERMAL PROJECT

(The "Project")

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I. EXECUTIVE SUMMARY

A. Introduction

This Report is intended to provide an overview of the current status, anticipated future development efforts and realistic financial prospects for a large-scale geothermal power production and submarine electrical transmission cable project (the "Project") being considered for the State of Hawaii. This Report will present such information in a practical manner so that it can be of the greatest usefulness to private industry and financial institutions who may consider participating in certain aspects of Project implementation.

The Hawaii Deep Water Cable Program (HDWC Program) initiated in October 1981, is a multi-year $27 million research and development program to determine the technical and economic viability of a submarine power transmission cable system between the Island of Hawaii and Oahu over a 30 year operating period.

The State of Hawaii views a submarine transmission cable as critical to its energy future, since geothermal energy is the only large-scale, indigenous, non-petroleum-based power source that is commercially viable. Geothermal resources are predominantly located on the Island of Hawaii, where it is believed that the ultimate power generating potential is in excess of 1,000 megawatts of capacity.

However, more than eighty percent of the State's 1,200 megawatt peak power demand is on the Island of Oahu. By undertaking the Project, the State would be able to achieve a significant degree of electrical energy self-sufficiency through essentially one interconnected multi-island power grid.

The approach taken throughout this overview economic and financial feasibility assessment is to focus upon the major technological, construction, operations, economic and regulatory risks (whether actual or perceived) inherent in the Project. These risks will have to be addressed by contractual arrangements among the participants in the Project, in order to successfully attract the $1.5 billion or more of private capital needed to build the Project. In specific terms, the perspective of this Report is that of a financial advisor and investment banker undertaking the contractual negotiations and international financing source negotiations required for a large-scale, technically-complex energy production facility.

B. Current Technical Review Status

During Phase I of the HDWC Program, the major design elements of the submarine transmission cable were investigated, including materials characteristics (type, composition and weight) and dimensions for the cable conductors, insulations, sheaths and armors. Five basic cable designs were identified that could operate successfully in the deep ocean around Hawaii. In the subsequent Phase II, a comprehensive cable design parametric study was completed to identify the most commercially appropriate cable. The selected cable is a +/- 300 KVdc, "self-contained oil filled" (SCOF) cable, sized to provide up to 250 megawatts of electrical transmission capacity through a single cable. An illustrated cross-section and design specifications for the cable are shown in Figure 1 and Table 1.

To physically verify this selected design, a 6,000 foot length of cable has been fabricated for use in a series of laboratory electrical and mechanical tests in 1988. A 30,000 foot length of surrogate cable will be subjected to at-sea deployment and retrieval tests in late 1989.

In 1978, the Hawaii Geothermal Resources Assessment Program was initiated under a grant from the U.S. Department of Energy. The initial efforts identified 20 Potential Geothermal Resource Areas (PGRAs) based upon review of existing geological, geochemical and geophysical information. This was followed by a series of field testing studies, using various established surface and subsurface exploration techniques. These studies identified the Kilauea Rift Zone on the Island of Hawaii as having the highest probability (80%-100%) for moderate (+125 degrees C) to high (+350 degrees C) temperature geothermal resources (See Figure 3). The Kilauea Volcano is the youngest and most active volcano in Hawaii, with major eruptions on a one to three year basis. Currently, it is in an extended period of frequent activity that started in January 1983. The Kilauea Southwest Rift Zone, the site of recent eruptions in 1971 and 1974, has a 70 to 80% probability of power generation quality resources and the Kilauea East Rift Zone (Puna District), the site of eruptions during 1987, has had successful deep well drilling and flow testing over a period of several years.

The most important aspect in designating the overland portion of the route is to minimize both the short-term and long-term environmental and land use impacts from construction and energizing of the above ground transmission facilities.

Conversely, the most important aspect in designating the undersea route for the cable is to minimize the physical stresses placed upon the cable by the ocean floor geology particularly in the 6,300 foot deep Alenuihaha Channel between Hawaii and Maui. In addition, the SCOF cable design, requires a constant pressurization of the oil filling the cable. Given the length of the cable and this pressurization requirement, there is also the need for an oil repressurization station at the intermediate on-shore landing point for the cable system on Maui.

C. Overview of Projected Costs and Schedule

Certain aspects of the final design for the cable system remain to be determined in the HDWC Program. In addition, the laboratory tests in 1988 and at-sea handling tests during 1989 will provide significant physical verification for the previously chosen design characteristics of the cable.

Three different types of cable would be used: (1) the SCOF cable (described in Section III) for the long distance and depth of the Alenuihaha Channel, (2) a solid cable with a single wire armor for the shallower portion of the distance between Maui and Oahu, and (3) a solid cable with double wire armor for the deeper portion of the Kaiwi Channel between Oahu and Molokai.

The most recent cost estimates made by Pirelli Cable Corporation in 1986 for the HDWC Program indicated a manufacturing cost of $187 million for the undersea cables. At the same time, Hawaiian Dredging and Construction Company estimated that cable transportation and deployment costs would be approximately $41 million.

In order to provide up to 500 megawatts of geothermal electric capacity on the Island of Hawaii, a large number of deep wells will have to be drilled to tap the steam reservoir and a network of steam gathering and distribution pipelines will be built to supply the steam-driven turbine generator power plants.

Precise estimates of the total cost for power plant construction and well drilling are difficult, due to the current lack of plant sizing and design criteria and limited well drilling experience in the Puna District. However, current estimates (utilizing reasonable assumptions for areas not yet delineated) have put the total cost of a 500 megawatt geothermal power generating system (wells, gathering pipelines and power plants) at $1.3 billion, split equally between well development costs and power plant and related equipment costs.

The onshore Project facilities include an AC-to-DC converter station located near the geothermal power plants in Puna; overhead HVDC transmission lines across the Island of Hawaii and an oil pressurization station on the northwest shore of Hawaii; an intermediate oil repressurization station and possible 50 megawatt power line tap at the cable's Maui landfall; HVDC transmission lines on Maui; a DC-to-AC converter station at the

Oahu landfall and interconnection facilities between the cable system and Hawaiian Electric Company's distribution grid on Oahu.

The overhead HVDC transmission lines would consist of two physically separated 500 megawatt capacity lines to provide redundancy and system reliability. The onshore transmission and conversion facilities represent proven, state-of-the-art technology in the utility industry. The most recent cost estimate for the onshore facilities of approximately $170 million was made for the HDWC Program in 1986 by Power Technologies, Inc.

The HDWC Program is currently scheduled to be completed by early 1990. Figure 5 indicates the current time schedule for commercial development, construction and start of operations for the Cable System. A parallel development schedule for the geothermal power plants and wells would take place on a coordinated basis.

D. Proposed Development Organization and Regulatory System

In January 1988, the Advisory Board issued a report to the Governor concluding that the State must take a strong leadership role in facilitating the coordinated development of the Project and recommending that review and assessment work on the Project be continued. The Advisory Board also proposed actions to be taken by the Hawaiian Legislature to support the on-going development of a master plan for implementation of the Project. The Governor has introduced a bill into the January 1988 Session of the Legislature to establish a comprehensive permitting system for the development of the Project. The Legislature is currently considering enactment of an amended version of the bill, as introduced.

Chapter 269 of the Hawaii Revised Statutes provides generally that any person who owns, controls, operates or manages any plant or equipment directly or indirectly for public use, for the production, conveyance, transmission, delivery or furnishing of power, is subject to the jurisdiction of the Hawaii Public Utilities Commission (the PUC).

Chapter 269 does, however, provide two exemptions from PUC regulations that are relevant to the Project. First, it exempts any person who (i) controls, operates or manages plants or facilities for production, transmission or furnishing of power primarily or entirely from non-fossil fuel sources, and (ii) provides, sells or transmits all of such power, except power used in its own internal operations, directly to a public utility for transmission to the public. Second, it exempts producers of geothermal steam or electric energy generated from geothermal steam. It also authorizes the PUC to direct those public utilities supplying energy to the public to arrange for and acquire electric energy generated from non-fossil fuel sources in order to reduce to the greatest extent possible the use of fossil fuels in the generation of such electric energy. The rate for purchase paid by the utility to the alternate energy producer shall be as agreed between them and approved by the PUC. Should the parties be unable to agree, the PUC shall establish the purchase rate. The rate shall be just and reasonable and shall be not less than 100% of the cost avoided by the utility when the utility purchases the electrical energy rather than producing the electrical energy itself. The PUC shall determine the rate pursuant to the avoided cost approach of the federal Public Utilities Regulatory Policies Act (PURPA), and establish a minimum rate floor, "giving consideration not only to the near-term adverse consequences to the ultimate consumers of utility provided electricity, but also to the long term desirable goal of encouraging to the greatest extent practicable, the development of alternative sources of energy".

Although the cable transmission system does not appear to be a public utility subject to PUC regulation, the PUC nonetheless has the statutory authority to require the transmission of geothermally-generated electric energy from the Island of Hawaii to Oahu through the cable system.

In summary, current State public utilities law presumes a regulatory role for the PUC in approving the contractual pricing, business terms and other conditions relating to the pricing of geothermally-generated electricity and its transmission to HECO, as well as HECO's ultimate sale of such energy to the public. The PUC would not, however, have direct regulatory authority to review the general business, financial or managerial decision-making of the geothermal energy producers or the owners and operators of the deepwater transmission cable system.

Based upon the current level of private entity involvement in geothermal development on Hawaii; the significant amounts of capital that will be required to explore and develop 500 megawatts of geothermal power production capacity and the specialized technical and engineering expertise necessary for such a successful development effort, one or more private entities, working separately or in several joint ventures or consortia appear to be the most appropriate owners for the geothermal production capacity on Hawaii.

The legal form and business relationships among the various private entities undertaking the geothermal development could be one of several organizations available to private parties, although the most likely commercial enterprises are: (1) a corporation, (2) a general or limited partnership or (3) a joint venture. Either of these entities could be formed under Hawaii law or under the laws of another jurisdiction and then qualified to do business in Hawaii.

One of the most important conclusions reached by the Governor's Cable Advisory Board in its January 15, 1988 report to the Governor, was to view the geothermal power production facilities and the deep water cable transmission facilities as interrelated parts of an overall coordinated development effort.

It is very clear that the development of a commercial cable system cannot be examined in isolation, particularly because the costs involved and the possible financing approaches to fund those costs depend upon ensuring that a cable system will be able to assure the generation of sufficient revenues to satisfy the requirements of the financing and provide a reasonably reliable supply of electric energy to Oahu.

Equally fundamental, the purpose of a commercial cable system would be to transmit electric energy generated from the geothermal resources on the Island of Hawaii to Oahu. It would be financially infeasible to raise the required financing for a cable system and then actually to install that system without the coordinated development of the renewable alternate energy electric production facilities to provide energy to be transmitted upon completion of construction and acceptance testing of the installed cable. The private geothermal resource developers currently active on Hawaii have clearly stated that they would not undertake the substantial investment of effort and might be unable to obtain required financing to develop the geothermal resources that they have under lease without a very firm assurance that they would be able to transmit such energy to Oahu through the cable upon completion of construction of their geothermal power plants. As a consequence, it is possible that the same private companies or joint ventures that are selected by the State to act as developers and owners of the geothermal power facilities may also undertake the development and ownership of the deep water cable transmission facilities. However, it is equally possible that due to the magnitude of the construction effort, potential financial risks and the different technical and engineering expertise required for the cable system, totally separate private companies may pursue development of the transmission facilities, while on a parallel path, other private entities develop the geothermal production facilities. In either case, one of the major responsibilities of the State will be to coordinate the possibly separate private development efforts for both the geothermal production and transmission phases of the overall Project.

In 1983, the State Legislature enacted the Geothermal Resource Subzone Assessment and Designation Law (Act 296-83). This law mandated the creation of "geothermal resource subzones" within which geothermal exploration and development could take place, regardless of prior land use restrictions. Under this law the State Department of Land and Natural Resources (DLNR) established geothermal resource subzones based upon a number of factors, including: (1) potential for production of geothermal energy, (2) use of geothermal energy in the area, (3) geologic hazards, (4) social and environmental impacts, (5) compatability with present permitted land uses, (6) potential economic benefits and (7) compatability with conservation policies for subzones within conservation districts.

In order to more closely coordinate the permitting process for the interrelated geothermal power production and deep water transmission cable portions of the Project, the Governor submitted to the State Legislature in January 1988 a bill to establish a consolidated permit application and review process (S.B. 3182, the Permit Bill). As approved by the State Legislature in April 1988, the Permit Bill designates the DLNR as the "lead agency" to establish and administer a consolidated permitting process involving the various federal, State and county agencies that must approve the construction and operation of the Project.

This consolidated permitting process is intended to promote the development and financing of the Project by private companies by coordinating the multiple State and county agency jurisdictions for approvals presently necessary for geothermal and cable development, thereby reducing the time and risk capital that may be required to permit and develop the Project. In addition, by coordinating the permitting of both the geothermal resources and the cable system in one regulatory process, the development of a single integrated Project is encouraged. The Coordinated Permit Application Review Process would include all State and county level permitting functions involved in the development of the Project and all federal agencies willing to participate and will have several components: (i) the master list of permits required for the Project; (ii) a master coordinated schedule for various permit reviews and approval deadlines for the Project; (iii) an interagency group to coordinate the permit application and review process for the Project; and (iv) a joint agreement among the members of the interagency group to be used in implementing the actual reviews and hearings for the Project for all permitting purposes.

The Permit Bill also provides for the DLNR, as the lead agency, to establish an interagency group comprised of the DLNR, those State and county agencies whose permitting functions have not been transferred to the DLNR, and, where possible, federal agencies to undertake certain permit facilitating and agency liaison functions. This interagency group will be used to ensure cooperation in coordinating the permit review process by the various agencies to the greatest extent possible.

In general terms, the Permit Bill has been designed to enable the State, through DLNR, to provide effective overall direction and coordination for the development and permitting of the Project and to encourage the greatest possible private company involvement in the actual construction, financing and operation of the Project.

As currently contemplated, the State (through establishment of an Authority or through an existing agency) will use its relatively broad and flexible oversight and coordination powers to enter into contractual arrangements with private third parties for the development, financing, construction and operation of the Project. As a result, the State and its legal and financial advisors will be able to negotiate with various private companies to provide equipment, construction, financing, operations or other services required to implement the Project. This type of governmental involvement is similar in basic respects to that recently employed for the organization and recent successful financing of the $10.4 billion Eurotunnel project between England and France. The Eurotunnel project proposes to build over a six-year period a 31 mile underground transportation system beneath the English Channel. In 1984, the British and French Governments revived an earlier effort dating back to 1975 to sponsor the development of such a project.

The practical implementation of the Project, will necessitate a similar public sponsored and controlled development approach, utilizing private company contractors and relying principally upon private sector financing sources negotiated by the State and its advisors on a "project-recourse" basis.

E. Anticipated Project Financing Arrangements

In order to develop the most appropriate overall financing plan for the Project, it is first necessary to analyze the nature and extent of various risk factors inherent in the development, construction and operation of the Project.

Potential investors providing debt or equity financing for the Project are particularly concerned with any risk that may delay or prevent the completion of the Project or reduce the net revenues generated from the completed Project. The following are the key Project risks of concern to lenders and investors in terms of both the Project's lifecycle phases and its operational characteristics:

1. Project Financing Risk Periods. Different financing credit risks will occur at different times in the course of the Project's construction and operation. These fall into three periods: (i) the engineering and construction phase; (ii) the start-up phase; and (iii) the operational

phase. Different guarantees and undertakings provided by different private contract participants must be used in each phase to provide the credit support necessary for structuring a project financing.

2. Specific Project Financing Risks. During the various risk periods discussed above, there are several specific project financing risks that are inherent in the Project's characteristics. Many of these risks can be mitigated by careful financial planning and negotiation of contracts to allocate responsibility for specific risks among the private participants in development, construction and ownership of the Project.

    a. Market and Price Risks. The only source of revenues that the Project can generate are those derived from the production and sale of the electrical output resulting from operation of the Project. As a result, there must be an assured purchaser and a methodology or formula for determining the electrical price at which the output will be sold over the length of time necessary to repay the lenders and investors in the Project.

    b. Geothermal Resource Availability Risks. The supply of the reservoirs to be used by the Project to generate its electricity must be more than sufficient to ensure successful operation for the duration of the project financing and beyond. In addition, those resources must be available at a cost consistent with the Project's financial projections used as the basis for the financing.

    c. Technological Risks. One of the most challenging issues in designing a financing plan for the Project will be the respective technologies used both to produce geothermal electric energy and transmit that energy to Oahu.

    d. Insurance Coverage for Risks. Certain risks associated with the development, construction and operation of the Project, are not easily foreseeable or controllable through contract allocations. Some of these "force majeure" types of risks can, however, be mitigated through a well-designed insurance risk management program. An adequate insurance program must encompass both the construction and operational phases of the Project, covering the replacement costs of major Project facilities or components.

The contractual arrangements referred to above seek to minimize the financial impact of certain risks that will be inherent in the construction or operational phases of the Project. These risk mitigation arrangements will enhance the ability of the Project to meet its financial obligations to investors on a truly "stand-alone" basis. In actual negotiations by the State, some of these risks may not be properly or fully mitigated by contractual agreements with the private builders and operators of Project facilities.

However, the objective in negotiating the contractual arrangements for the Project will be to package and combine the risk undertakings of various private company participants in such a way that the overall credit responsibility for the Project is allocated among the participants instead of assumed by a single party and allocated in a manner acceptable to both the private contractors as well as the State and the Project's equity investors. The techniques that can be used to mitigate and allocate the Project's major risks are diverse and are limited only by the ingenuity of the State and its legal and financial advisors and their acceptability to the private contractors and investors. The key principle in these often complex and difficult contractual negotiations will be to eliminate or greatly mitigate various Project-related risks or if not mitigated, to allocate these risks among the private participants on the basis of: (1) the participant best able to influence specific risks and/or (2) the participant best able to bear some portion of the financial impact of specific risks if they occur, in spite of various mitigation efforts.

3. Sources of Funding for the Geothermal Power Production and Transmission Facilities

As discussed in Section V.C., it appears that the most likely investors in both the geothermal power production facilities and the transmission cable system will be private companies, which may include various construction contractors, equipment vendors, geothermal resource developers, financial institutions and/or industrial corporations.

In general, the private entity financing approach would involve a combination of (i) an investment by the private entity itself, (ii) long-term debt in the form of either taxable interest rate loans obtained from institutional lenders (e.g., commercial banks, insurance companies and major pension funds) and/or long-term debt in the form of tax-exempt interest rate bonds.

a. Equity Investment. In financing the Project, the private owners would generally be required to provide as its investment in the project an amount equal to at least twenty percent of the construction costs. This would be true regardless of whether the private entity were a corporation, a partnership or joint venture (See Section V.C.). The actual percentage that would be required for the equity investment would ultimately be determined by the projected net operating revenues of the cable system, the relative amounts of debt service coverage margins and the expected rate of return on equity required by the investors. The ways in which this equity investment could be invested are:

(1) Direct Capital Contributions. The private owners could simply contribute the required project equity amount directly from its own funds. This is clearly the most straightforward approach but it does impact adversely on the owners' cash reserves and cash flows. Alternatively, the private owners could borrow these funds and then contribute them to the Project. This, however, incurs a separate debt obligation, which must eventually be repaid together with interest on the borrowed principal. This could similarly adversely affect the owners' cash flows and general credit rating.

(2) Leveraged Lease Financing. Leasing in general and leveraged leasing in particular are methods of private ownership financing that are often used in a project financing. In a lease financing, the operators of the Project assets leases the assets from a financial institution as "owner-lessor" rather than owning the asset and financing its development and acquisition through direct borrowings. If the lessor, as an equity investor and the legal owner of the asset, has borrowed some of the funds to pay for the asset, the financing is a leveraged lease financing.

b. Taxable Interest Rate Loan Financing. The private owners would obtain most of the funds needed to construct the Project (up to eighty percent) through taxable interest rate loans or tax exempt interest rate bonds or a combination of the two. This subsection will discuss taxable interest rate loan financing, and Subsection 3. below will discuss tax-exempt interest rate bond financing.

Taxable interest rate loan financing is generally obtained from major institutional lenders such as banks, insurance companies and major pension plans. Historically, commercial banks have been the single most active source of debt for large project financings, such as the Project.

As a general rule, banks prefer to limit their lending commitments to the period encompassing the construction phase and eight to twelve years of loan amortization following completion of construction, with floating interest rates pegged to the U.S. Prime Rate, the cost of certificate of deposit borrowings by the banks or the London Interbank Lending Rate (LIBOR). For projects of the cable system's magnitude it is typical for a group of banks to form a syndicate to provide the lending commitment.

c. Tax-Exempt Interest Rate Bond Financing. Along with or in place of taxable interest rate debt, another financing source that is available to the private owners involves industrial development revenue bonds (IDBs). Section 103 of the Internal Revenue Code of 1954 (the Code) provides that the interest earned by a purchaser of bonds issued by a state or municipality will be tax-exempt, provided that the bond issue complies with the requirements of that Section and the regulations adopted thereunder.

(1) Section 103(b)(4)(E) of the Code, provides that interest on a bond issue will be tax-exempt if substantially all of the proceeds are to be used to provide "facilities for the local furnishing of electric energy or gas", which include land or depreciable property which is used in the trade or business of furnishing electric energy or gas to produce, collect, generate, transmit, store, distribute or convey electric energy or gas and which is part of a system providing service to the general populace of one or more communities or municipalities, but in no event more than two contiguous counties (or the political equivalent thereof) or not more than one city and a contiguous county (the "two county rule").

(2) Volume Limitations on IDB Financing. There is a potentially more serious limitation to the use of tax-exempt bonds to finance the Project. The total amount of all IDBs that can be issued annually within each state is also limited by Section 103 of the Code. The amount of tax-exempt IDBs that can be issued within Hawaii during any one calendar year is limited to the greater of $50 per resident or $150 million. To satisfy this limitation for the Project costing $2.0 billion or more tax-exempt IDBs would need to be issued over ten or more calendar years. Such an extended construction and financing period may not be economically viable, due to the increased

amount of interest charges that would accrue prior to the full operation of the Project.

(3) IDB Financing Under Hawaii Law. Pursuant to H.R.S. Chapter 39A, Part VI, Special Purpose Revenue Bonds (SPRBs) -- which are tax-exempt IDBs under Section 103 of the Code -- may be issued through the State Department of Budget and Finance (B&F) to assist regulated utilities serving the general public in providing electric energy under the "two county rule". However, as discussed in Section V.B., the private owners of geothermal power production or transmission facilities are not deemed to be a regulated utility and thus would not qualify for SPRB financing under H.R.S. Chapter 39A, Part VI absent a special amendment to that statute by the Legislature.

d. Foreign Government Export Credit Financing. Foreign governmental export credits, if available, could provide an additional portion of taxable interest rate debt financing for major items of equipment and/or other goods and services provided for the Project by non-U.S. manufacturers and equipment vendors.

The availability of export credit financing for the Project will depend upon the extent to which foreign-manufactured equipment is chosen by the State in its competitive negotiations with equipment suppliers and contractors.

4. Contract Security Relationships Between Geothermal Power Production and Transmission Facilities

As discussed in Section VI A. and B., it is possible that different private parties may act as owners and/or prime contractors for the geothermal power production and deep water cable portions of the Project, given the magnitude of Project costs and differing nature of technical risks involved. In such a case, it will be extremely important that the interrelated nature of these two portions of the Project be properly addressed in the risk allocation contract negotiations.

As during the construction phase of the Project, allocating the risks and responsibilities for various potential interrelated operating failures would require extremely complex and difficult negotiations between the State, its legal and financial advisors and various private contractors, owners and their respective advisors.

However, carefully negotiating these risk allocations and liquidated damage penalties to provide reasonable levels of financial security to lenders and equity investors, will be the key to any successful financing plan for the Project.

F. Operational Arrangements for the Project

Along with the various construction period risks that must be mitigated through the contractual arrangements discussed in Section VI.B. and E., there are various operational period risks that must also be addressed. Investors in a non-recourse financing for the Project will insist that either the Project's sponsors or other parties as operators under long-term contracts possess the technical expertise to operate and maintain the Project and the experience in operating similar power generation and/or transmission facilities. Such operations and maintenance contracts should condition the payment of certain bonuses to, and impose penalties for substandard performance on, the operating contractors, based upon the actual performance levels achieved by the Project and the ability of the Project's revenues to meet all financial and operational costs.

As outlined above, it is likely that the operation of the Project's geothermal power production and cable transmission facilities will be undertaken by various private parties, as owners, turnkey builders and/or long-term contract operators. In this case, HECO's likely role would be to coordinate and facilitate the integration of the geothermal electricity produced and transmitted from the Project, with the varying daily and seasonal fluctuations in power demands on Oahu. Electrical grid system issues that must be addressed in conjunction with HECO include the amount of required spinning reserves, maintenance of short-circuit levels, any modifications of current must-run units on Oahu to cycling units and back-up supply for loss or major blocks of transmitted geothermal power.

As discussed in Section V.B. above, the PUC is anticipated to maintain its existing regulatory authority over the pricing and other business terms of HECO's purchase of geothermal electricity from the Project. The actual parties to the power sales agreement with HECO will be influenced by the ownership arrangements for the Project. Specifically, if the geothermal generation power plants and the transmission cable are owned by separate private parties, the geothermal producers may contract HECO to purchase power delivered on Oahu and separately with the private owners of the transmission cable for transmission services to deliver the power from Hawaii to Oahu.

As discussed in Section VI.A and B. above, a probable power pricing methodology would be a "take-if-produced, cost-of-service" agreement whereby the actual costs of producing and transmitting Project power would be recovered through a charge per kilowatt/hour of electricity delivered to HECO on Oahu. Such a power sales contract between the Project and HECO would, of course, be subject to the PUC's review and approval of its terms.

G. Major Conclusions and Recommendations

Introduction

This Report has attempted to present a concise but complete overview of the current status of development investigations relating to the proposed large-scale geothermal power production and submarine electrical transmission cable facilities between the Islands of Hawaii and Oahu (the "Project"). In addition, the Report has described a scenario for the future development, financing and implementation of the Project which seems to be most appropriate, given the technical challenges and financial magnitude of the Project, the capabilities and interest of the private sector and the overriding public policy and economic concerns of the State Government. This Report has also evaluated the probable financial viability of the Project, based upon currently known design and cost factors and a likely private, project-supported financing plan. Throughout this Report, the emphasis has been placed upon properly addressing the various "real world" risks and trade-offs that will be inherent in devising Project development, ownership and financing approaches that will satisfy the requirements of lenders and investors in the international capital markets. Finally, this Report has attempted to present such information in a practical manner most useful to private industry and financial institutions who may consider participating in the Project.

Major Conclusions

1. The Project should be owned and financing arranged utilizing private funding sources and development groups. This approach is most appropriate for several reasons: (a) the $1.5 billion or more cost of the Project is beyond the financial resources available to the State or local governments; (b) there are significant tax benefits under the current Internal Revenue Code that would be available to private owners of the Project's facilities and (c) if various Project-related risks are properly addressed through contract negotiations, the private capital markets have the ability and willingness to provide the debt and equity funds required for construction and operation of the Project.

2. <u>Enactment of legislation to establish a coordinated and streamlined permitting process for the Project was essential to encourage the maximum private sector participation in the Project</u>. Without such legislation, the risks inherent in the existing State and local government permitting processes relating to time delays, multiplicity of permit requirements and resulting costs would have significantly discouraged the degree of involvement of private parties in the up-front development risk phase of the Project.

3. <u>The State Government should play a major role in the continuing oversight and participate in the coordinated development and decision-making relating to the Project</u>. The magnitude of the Project and its probable impact upon not only the energy supplies of Hawaii, but also its economy and environment necessitate the active involvement of the State Government, on behalf of its citizens. The complexity of such a Project and its various interrelated aspects go beyond the boundaries of the normal concerns of a private commercial transaction and are outside of the narrowly defined issues involved in small-scale cogeneration or independent power sales contracts with electric utilities. In addition, the magnitude of the Project (in relation to HECO's existing generation on Oahu) would be significantly greater than that envisioned for independent cogeneration power projects by PURPA or actually experienced by other states implementing this federal law. This necessary supervisory role for the State Government has been borne out by the practical experiences of other development projects of similar scale and impact, such as the recent Eurotunnel project. The governmental body through which such supervision should be given (i.e. separate authority vs. existing administrative agency or department) and the exact scope of responsibilities of such body should be determined by the State Administration and the Legislature.

4. <u>Based upon current economic and financial information for the Project, it appears to be economically viable, practically financable on a project-supported credit basis and should provide significant savings in energy costs on Oahu during its operating lifetime</u>. This present assessment indicates that additional development, technical, economic and financial investigative work is warranted to verify the final costs and benefits that would result from construction and operation of the Project during the 1990's.

II. INTRODUCTION

A. Purpose and Scope of Analysis

This Report is intended to provide an overview of the current status, anticipated future development efforts and realistic financial prospects for a large-scale geothermal power production and submarine electrical transmission cable project (the "Project") being considered for the State of Hawaii. This Report will present such information in a practical manner so that it can be of the greatest usefulness to private industry and financial institutions who may consider participating in certain aspects of Project implementation.

In addition, this Report will provide information for the State Legislature and citizens of Hawaii, as background for future consideration of enacting bills relating to the development and implementation of the Project.

B. Project Background and Participating Entities

The Hawaii Deep Water Cable Program (HDWC Program) initiated in October 1981, is a multi-year $27 million research and development program to determine the technical and economic viability of a submarine power transmission cable system between the Island of Hawaii and Oahu over a 30 year operating period.

The State of Hawaii views a submarine transmission cable as critical to its energy future, since geothermal energy is the only large-scale, indigenous, non-petroleum-based power source that is commercially viable. Geothermal resources are predominantly located on the Island of Hawaii, where it is believed that the ultimate power generating potential is in excess of 1,000 megawatts of capacity.

However, more than eighty percent of the State's 1,200 megawatt peak power demand is on the Island of Oahu. By undertaking the Project, the State would be able to achieve a significant degree of electrical energy self-sufficiency through essentially one interconnected multi-island power grid.

The HDWC Program has been funded by the Federal and State Governments and is scheduled for completion in 1990. The HDWC Program has drawn from various public, private and educational bodies for expertise, with Hawaiian Electric Company, Inc. (HECO) as prime contractor utilizing Ralph M. Parsons Company through its Honolulu office (Parsons Hawaii) as major subcontractor. The Department of Business and Economic Development (DBED) has taken primary oversight responsibility for the HDWC Program on behalf of the State.

C. Perspective for Analysis

The approach taken throughout this overview, economic and financial feasibility assessment is to focus upon the major technological, construction, operations, economic and regulatory risks (whether actual or perceived) inherent in the Project. These risks will have to be addressed by contractual arrangements among the participants in the Project, in order to successfully attract the $1.5 billion or more of private capital needed to build the Project. In specific terms, the perspective of this Report is that of a financial advisor and investment banker undertaking the contractual negotiations and international financing source negotiations required for a large-scale, technically-complex energy production facility.

III. CURRENT TECHNICAL REVIEW STATUS

A. Deep Water Cable Design and Development

During Phase I of the HDWC Program, the major design elements of the submarine transmission cable were investigated, including materials characteristics (type, composition and weight) and dimensions for the cable conductors, insulations, sheaths and armors. Five basic cable designs were identified that could operate successfully in the deep ocean around Hawaii. In the subsequent Phase II, a comprehensive cable design parametric study was completed to identify the most commercially appropriate cable. The selected cable is a +/- 300 KVdc, "self-contained oil filled" (SCOF) cable, sized to provide up to 250 megawatts of electrical transmission capacity through a single cable. An illustrated cross-section and design specifications for the cable are shown in Figure 1 and Table 1.

To physically verify this selected design, a 6,000 foot length of cable has been fabricated for use in a series of laboratory electrical and mechanical tests in 1988. A 30,000 foot length of surrogate cable will be subjected to at-sea deployment and retrieval tests in late 1989.

While cable designs were being evaluated, the characteristics and capabilities of all potential cable deployment and retrieval vessels were studied and a resulting cable vessel and handling equipment conceptual design prepared. The results of this work indicate that a 400 foot long by 100 foot wide vessel with stern-mounted handling equipment was best suited to the cable design and ocean currents that will act on the vessel while the cable is being deployed (See Figure 2).

B. Geothermal Resource Testing and Power Generation

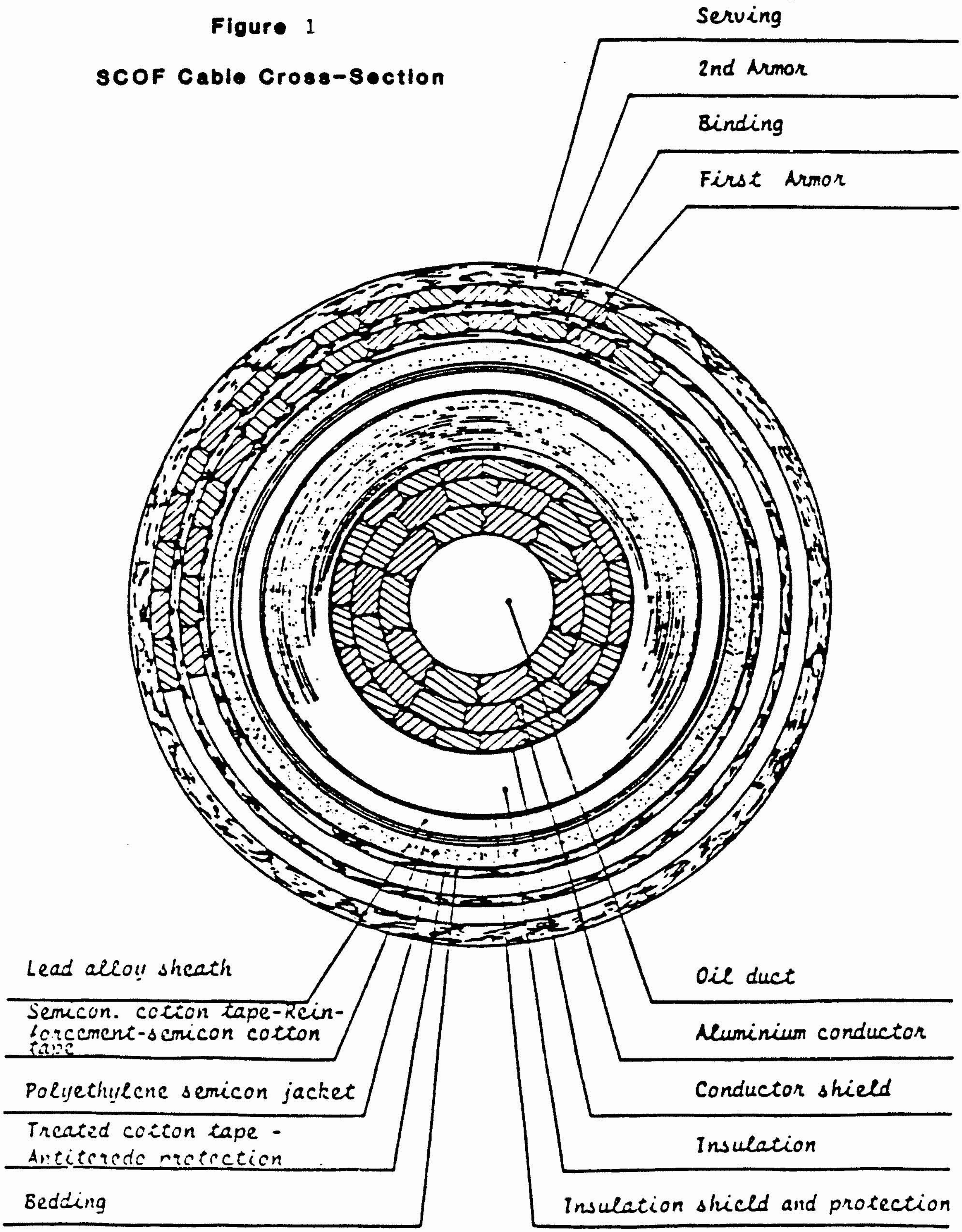
In 1978, the Hawaii Geothermal Resources Assessment Program was initiated under a grant from the U.S. Department of Energy. The initial efforts identified 20 Potential Geothermal Resource Areas (PGRAs) based upon review of existing geological, geochemical and geophysical information. This was followed by a series of field testing studies, using various established surface and subsurface exploration techniques. These studies identified the Kilauea Rift Zone on the Island of Hawaii as having the highest probability (80%-100%) for moderate (+125 degrees C) to high (+350 degrees C) temperature geothermal resources (See Figure 3). The Kilauea Volcano is the youngest and most active volcano in Hawaii, with major eruptions on a one to three year basis. Currently, it is in an extended period of frequent activity that started in January 1983. The Kilauea Southwest Rift Zone, the site of recent eruptions in 1971 and 1974, has a 70 to 80% probability of

WEIGHT OF CABLE IN AIR: 37kg/m (24.9 lb/ft)
WEIGHT OF CABLE IN WATER: 27kg/m (18.2 lb/ft)

PIRELLI
CABLE CORPORATION

Figure 1

SCOF Cable Cross-Section



Source: Pirelli Cable Corporation. 1985. Hawaii Deep Water Cable Program, Phase II: Cable Construction Specification. Prepared for The Ralph M. Parsons Co., Hawaiian Electric Co., Inc. and the U.S. Dept. of Energy.

Table 1

Selected Basic Design

Characteristics of Cable Design No. 116

PARAMETER	DESCRIPTION
Cable Type	SCOF
Voltage	$\pm$300 KVDC
Conductor Cross Section	1,600 sq mm (2.48 sq in)
Total Transmission Load	500 MW
Transmission Load Per Cable	250 MW
Rated Current Per Cable	833 Amps
Conductor Material	Aluminum
Oil Duct Diameter	25 mm (0.98 in)
Oil Type	High Density Synthetic Low Viscosity
Number of Cables for System	2 plus one spare
Polarity Reversal	Allowed
Conductor Diameter	51.9 mm (2.043 in)
Insulation Thickness	10.9 mm (o.429 in)
Cable Finished Diameter	118.4 mm (4.66 in)
Cable Weight in Air	37 kg/m (24.9 lb/ft)
Cable Weight in Water	27 kg/m (18.2 lb/ft)
Maximum Oil Feeding Length	190 km (118.1 mi)
Design Oil Feeding Pressure	30 atm (440 psi)
Losses at Rated Current Per Cable	12.4 kW/km
Pulling Tension for 7,000 Ft Water Depth (Based on PCC Formula)	65.1 mt (71.8 t)
Maximum Allowable Cable Pulling Tension	78.7 mt (86.8 t)
Corresponding Maximum Water Depth (Based on PCC Formula)	2,626 m (8,615.5 ft)
Minimum Allowable Bending Diameter	6 m (19.7 ft)

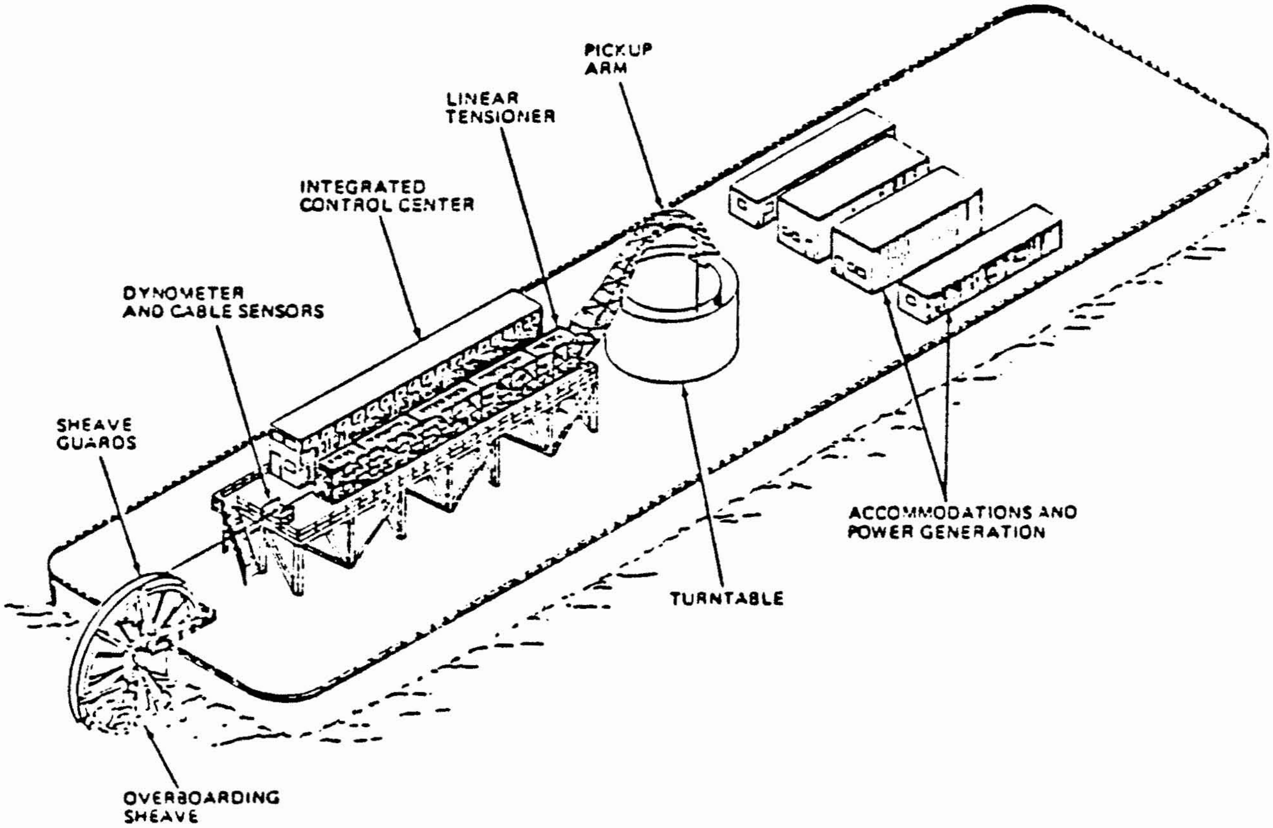
Source:

Pirelli Cable Corporation. 1985.

Figure 2

Conceptual Drawing of the Major Cable Handling

Machinery for the HDWC Program



Source:

Western Gear Machinery Company. 1986. Hawaii Deep Water Cable Program, Phase II: Cable Handling Equipment Concept Study. Prepared for Hawaiian Dredging and Construction Co., The Ralph M. Parsons Co., Hawaiian Electric Co., Inc. and the U.S. Dept. of Energy.

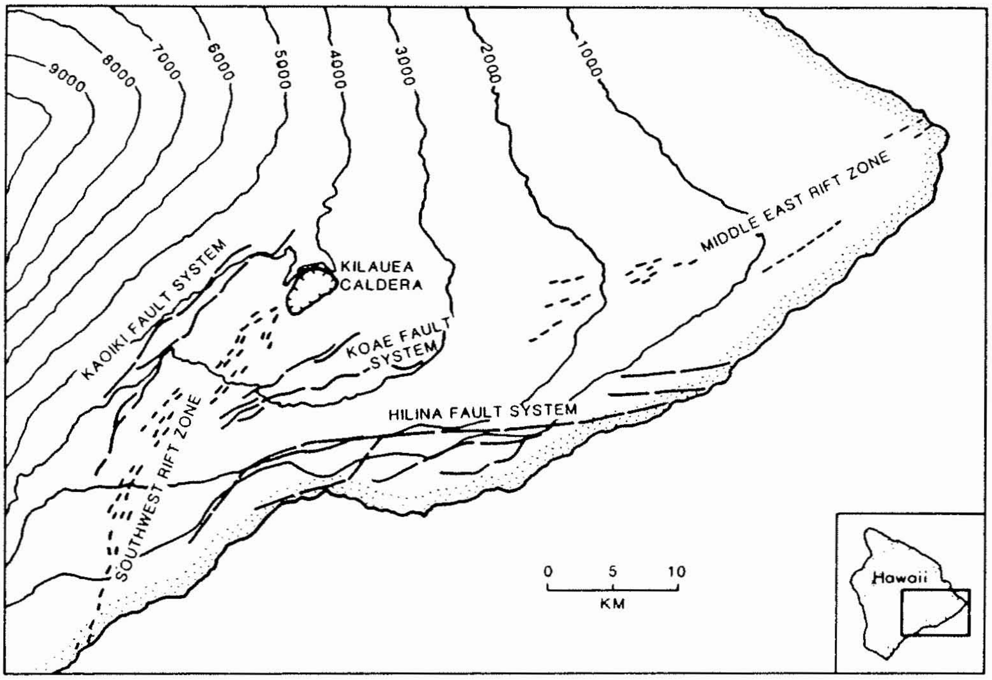


Fig. 3 Map of the summit and eastern flank of Kilauea volcano (Hawaii is.) showing the major fault systems.

Source:

Donald M. Thomas, "Geothermal Resources Assessment in Hawaii", Geothermal Energy in Hawaii, Report on the Invitational Workshop on Geothermal Technology for the Pacific Basin, Pergamon Press, Inc. Elmsford, N.Y., 1986.

power generation quality resources and the Kilauea East Rift Zone (Puna), the site of eruptions during 1987, has had successful deep well drilling and flow testing over a period of several years.

To demonstrate the power production potential of the Puna, the State and Federal Governments jointly funded a reservoir drilling program and construction of a 3 megawatt capacity geothermal power production facility, the Hawaii Geothermal Project (HGP-A). The working deep production well was opened in June 1981 and initial power generation began in July 1981. In March 1982, HGP-A was put into commercial operation by Hawaii Electric Light Company (HELCO) producing 2.4 megawatts continuous net output to the electrical grid. HGP-A has over the past five years operated at a 95% average availability, without any significant reduction in the flows of geothermal resources from the production wells.

In addition to HGP-A, there are presently two private joint ventures actively involved in geothermal exploration and development in the Puna area. The first is Puna Geothermal Venture, consisting of Thermal Power Company and Amfac Energy, Inc. This venture has drilled several exploratory wells and has obtained a power sales agreement with HELCO to provide 25 megawatts of geothermal power by the early 1990s. The second private venture is True/Mid-Pacific Geothermal Venture, working with the Campbell Estate. This venture received final regulatory approval in 1987 to begin exploratory drilling on 9,000 acres of Conservation District land owned by the Campbell Estate.

C. Overland and Undersea Transmission Routing

During the HDWC Program, environmental, aesthetics and oceanographic surveys have been undertaken to develop a cost-effective, preferred route for the cable transmission system from the Puna area of Hawaii to the eastern shore of Oahu, a distance of approximately 160 miles.

The most important aspect in designating the overland portion of the route is to minimize both the short-term and long-term environmental and land use impacts from construction and energizing of the above ground transmission facilities.

Conversely, the most important aspect in designating the undersea route for the cable is to minimize the physical stresses placed upon the cable by the ocean floor geology particularly in the 6,300 foot deep Alenuihaha Channel between Hawaii and Maui. In addition, the SCOF cable design, requires a constant pressurization of the oil filling the cable. Given the length of the cable and this pressurization requirement, there is also the need for an oil repressurization station at the intermediate on-shore landing point for the cable system on Maui.

Based upon the work to date in the HDWC Program, the "preferred route" shown in Figure 4 has been selected. This route encompasses a larger more general corridor within which a detailed transmission line alignment will be defined, subsequently.

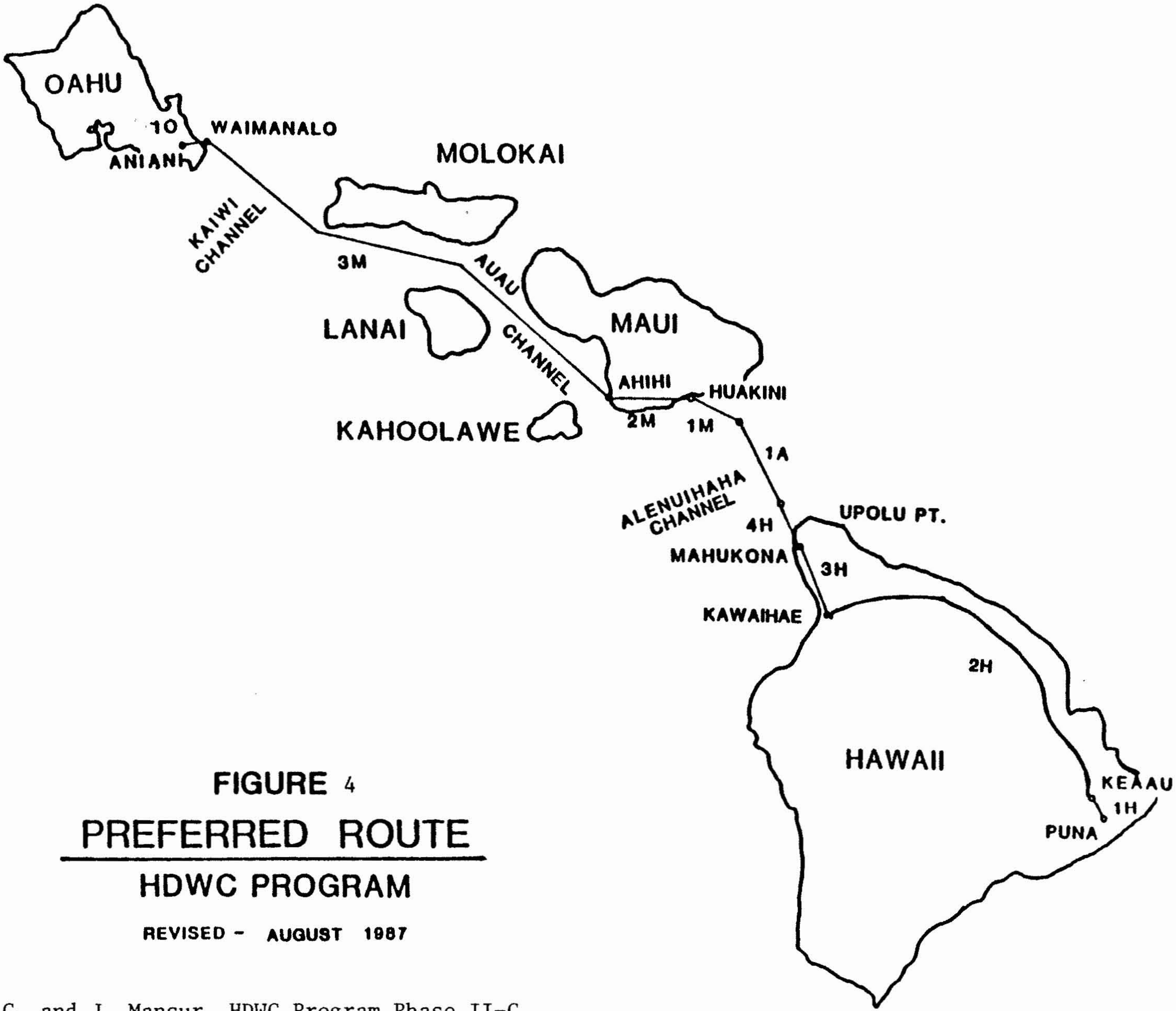


FIGURE 4

PREFERRED ROUTE

HDWC PROGRAM

REVISED - AUGUST 1987

Source:

Krasnick, G. and J. Mansur, HDWC Program Phase II-C Executive Summary, Parsons Hawaii, August 1987.

IV. OVERVIEW OF PROJECTED PROJECT COSTS AND SCHEDULE

A. Deep Water Cable System and Handling Vessel

Certain aspects of the final design for the cable system remain to be determined in the HDWC Program. In addition, the laboratory tests in 1988 and at-sea handling tests during 1989 will provide significant physical verification for the previously chosen design characteristics of the cable.

Nonetheless, the major elements of the 500 megawatt capacity, direct current transmission cable system can be summarized (See Table 2). The undersea portion of the system would consist of three separate cables, each having a transmission capacity of approximately 250 megawatts. This configuration allows one of the cables to serve as redundant back-up if either of the remaining two cables are damaged or are undergoing maintenance or repair. The undersea portion would extend approximately 138 miles, with the cable laid on top of the seabed including the deepest portions (6,300 feet) of the Alenuihaha Channel between Hawaii and Maui.

Three different types of cable would be used: (1) the SCOF cable (described in Section III) for the long distance and depth of the Alenuihaha Channel, (2) a solid cable with a single wire armor for the shallower portion of the distance between Maui and Oahu, and (3) a solid cable with double wire armor for the deeper portion of the Kaiwi Channel between Oahu and Molokai.

In addition to the costs associated with construction and operation of the cable handling vessel (described in Section III), there will be transportation costs for the cable sections from the manufacturer's factory to Hawaii and mobilization expenses for re-splicing and loading the cable onto the deployment vessel.

The most recent cost estimates made by Pirelli Cable Corporation in 1986 for the HDWC Program indicated a manufacturing cost of $187 million for the undersea cables. At the same time, Hawaiian Dredging and Construction Company estimated that cable transportation and deployment costs would be approximately $41 million.

B. Geothermal Power Production Plants and Wells

In order to provide up to 500 megawatts of geothermal electric capacity on the Island of Hawaii, a large number of deep wells will have to be drilled to tap the steam reservoir and a network of steam gathering and distribution pipelines will be built to supply the steam-driven turbine generator power plants.

TABLE 2

COMMERCIAL CABLE SYSTEM COMPONENTS

SUBSYSTEM	COMPONENT
Cable	Cables (possibly more than one design) Sea Return System Factory and At-Sea Splices Sheath/Grounding Joints Land/Sea Cable Joints or Terminations Cable Splicing Equipment Oil Pumps/Reservoirs - On-Board Transport and Laying Vessels and Shoreside* Spare Cable & Repair Equipment Storage
Vessel	Hull and Deck Propulsion and Maneuvering Navigation and Control Port Facilities Embedding Equipment Submersible and Support Equipment Operations and Crew Support Facilities Cable Locating Equipment (Electronic, Mechanical, Visual)
Cable Handling Equipment	Turntable Tensioner Overboarding Sheave Power Unit Control Modules Cable Orientation Guidance System
Shoreside Facilities	Rectifier/Inverter Equipment Intermediate Takeoff/Landing Facilities Overhead Lines Operations and Maintenance Facility

* If a SCOF-type cable is selected, the cable must remain pressurized while in transit from the factory and during laying.

Source:

Mountford, J.D., HDWC Phase II-C Studies, Progress Report, Power Technologies, Inc., December 1986.

It has been estimated that approximately 15 to 20 exploratory and testing wells will have to be drilled to prove the existence and extent of a commercially viable overall geothermal reservoir to support 500 megawatts of power production. In addition, for each specific power production plant, at least three successful production wells, and as many as fourteen wells depending upon plant capacity, will be dedicated to steam supply and for reinjection of fluids. Recent geothermal exploration experience indicates that each successful production well should support approximately 4 megawatts of electrical generation capacity.

The specific design configuration for the power production facilities has not been an aspect of the HDWC Program. However, the experience in the Geysers area of Northern California, which has the greatest concentration of actively producing geothermal power plants in the world, has resulted in the development of standardized 55 megawatt production units. Often two or more units are combined in a specific location, being supplied from the same area of the reservoir. However, due to the more geologically unstable nature of the Kilauea East Rift Zone, it may be necessary to more widely separate each power production unit to minimize the risks of outage.

Precise estimates of the total cost for power plant construction and well drilling are difficult, due to the current lack of plant sizing and design criteria and limited well drilling experience in the Puna. However, current estimates (utilizing reasonable assumptions for areas not yet delineated) have put the total cost of a 500 megawatt geothermal power generating system (wells, gathering pipelines and power plants) at $1.3 billion, split equally between well development costs and power plant and related equipment costs[1].

C. Onshore Transmission and Conversion Facilities

The onshore Project facilities include an AC-to-DC converter station located near the geothermal power plants in Puna; overhead HVDC transmission lines across the Island of Hawaii and an oil pressurization station on the northwest shore of Hawaii; an intermediate oil repressurization station and possible 50

1 Estimate by Decision Analysts Hawaii, Inc. based upon information from Puna Geothermal Venture and True/Mid-Pacific Geothermal Venture. Detailed cost breakdowns are shown in Section VIII herein.

megawatt power line tap at the cable's Maui landfall; HVDC transmission lines on Maui; a DC-to-AC converter station at the Oahu landfall and interconnection facilities between the cable system and Hawaiian Electric Company's distribution grid on Oahu.

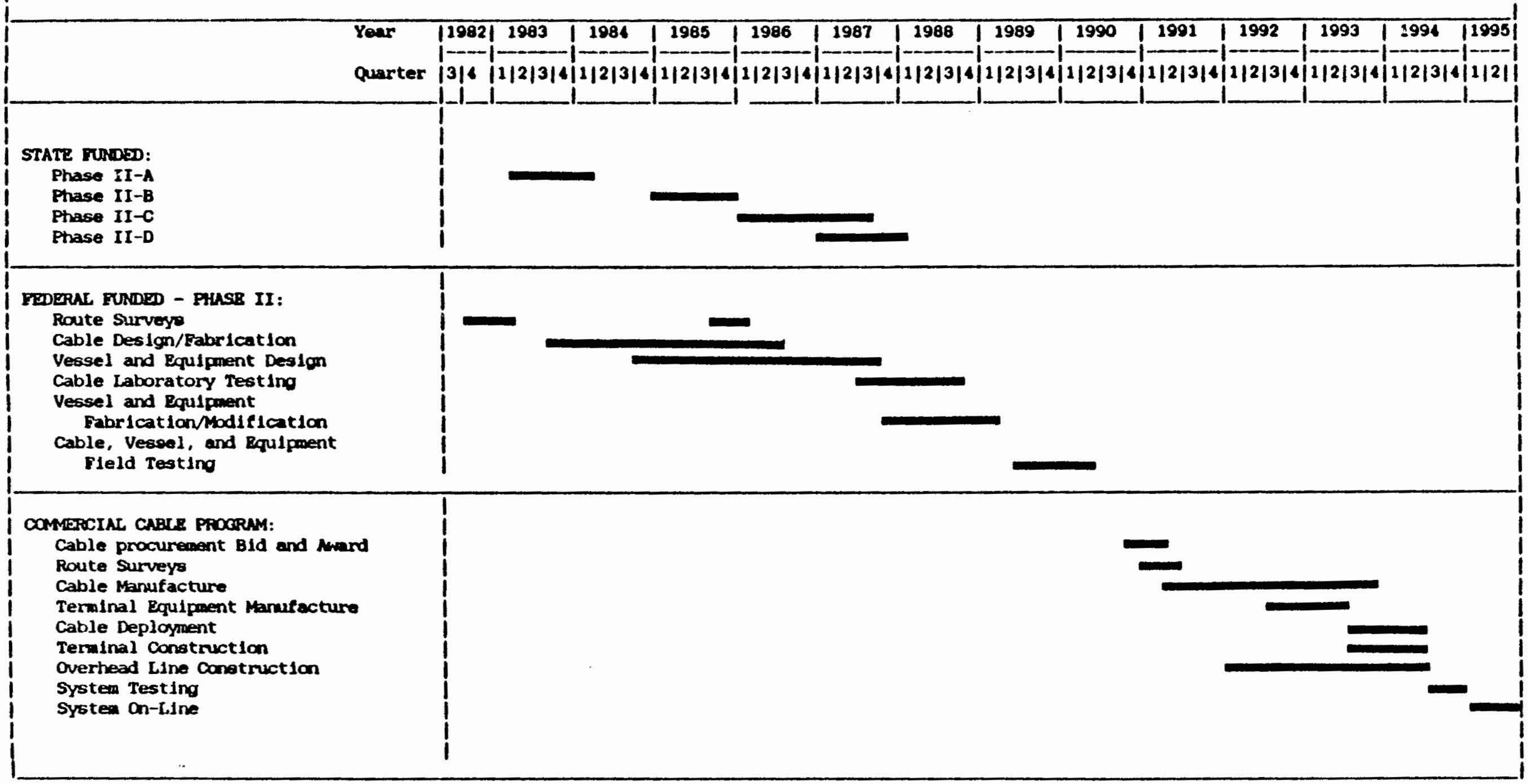
The overhead HVDC transmission lines would consist of two physically separated 500 megawatt capacity lines to provide redundancy and system reliability. The onshore transmission and conversion facilities represent proven, state-of-the-art technology in the utility industry. The most recent cost estimate for the onshore facilities of approximately $170 million was made for the HDWC Program in 1986 by Power Technologies, Inc.

D. Overall Project Development and Construction Schedule

The HDWC Program is currently scheduled to be completed by early 1990. Figure 5 indicates the current time schedule for commercial development, construction and start of operations for the Cable System. A parallel development schedule for the geothermal power plants and wells would take place on a coordinated basis.

It is important to note that in order to meet a 1990 construction start date, the coordinated development, permitting, selection of construction contractors and financing of the Project must begin before the end of 1988.

FIGURE 5
HAWAII DEEP WATER CABLE PROGRAM AND
COMMERCIAL CABLE SYSTEM DEVELOPMENT PLANNING SCHEDULE



Source:

Krasnick, G. and J. Mansur, HDWC Program Phase II-C Executive Summary, Parsons Hawaii, August 1987.

V. PROPOSED DEVELOPMENT ORGANIZATION AND REGULATORY SYSTEM

A. Institutional Oversight and Decision-Making Entity

Throughout the HDWC Program, the State of Hawaii has been represented by the DBED, working with the U.S. DOE and Hawaiian Electric Company. In 1987, Governor John Waihee also appointed an Advisory Board on the Underwater Cable Transmission Project (the Advisory Board) to assist the State in reviewing the technical, economic, financial and institutional feasibility of the Project.

In January 1988, the Advisory Board issued a report to the Governor concluding that the State must take a strong leadership role in facilitating the coordinated development of the Project and recommending that review and assessment work on the Project be continued. The Advisory Board also proposed actions to be taken by the Hawaiian Legislature to support the on-going development of a master plan for implementation of the Project. The Governor has introduced a bill into the January 1988 Session of the Legislature to establish a comprehensive permitting system for the development of the Project. The Legislature is currently considering enactment of an amended version of the bill, as introduced.

B. Public Utilities Commission Involvement in Project Regulation

Chapter 269 of the Hawaii Revised Statutes provides generally that any person who owns, controls, operates or manages any plant or equipment directly or indirectly for public use, for the production, conveyance, transmission, delivery or furnishing of power, is subject to the jurisdiction of the Hawaii Public Utilities Commission (the PUC).

Chapter 269 does, however, provide two exemptions from PUC regulations that are relevant to the Project. First, it exempts any person who (i) controls, operates or manages plants or facilities for production, transmission or furnishing of power primarily or entirely from non-fossil fuel sources, and (ii) provides, sells or transmits all of such power, except power used in its own internal operations, directly to a public utility for transmission to the public.[2] Second, it exempts producers of geothermal steam or electric energy generated from geothermal steam.[3] It also authorizes the PUC to direct those public utilities supplying energy to the public to arrange for and

2 H.R.S. 269-1(7)
3 H.R.S. 269-27.1(b)

acquire electric energy generated from non-fossil fuel sources in order to reduce to the greatest extent possible the use of fossil fuels in the generation of such electric energy.[4] The rate for purchase paid by the utility to the alternate energy producer shall be as agreed between them and approved by the PUC. Should the parties be unable to agree, the PUC shall establish the purchase rate. The rate shall be just and reasonable and shall be not less than 100% of the cost avoided by the utility when the utility purchases the electrical energy rather than producing the electrical energy itself. The PUC shall determine the rate pursuant to the avoided cost approach of the federal Public Utilities Regulatory Policies Act (PURPA), and establish a minimum rate floor, "giving consideration not only to the near-term adverse consequences to the ultimate consumers of utility provided electricity, but also to the long term desirable goal of encouraging to the greatest extent practicable, the development of alternative sources of energy".[5]

Although the cable transmission system does not appear to be a public utility subject to PUC regulation, the PUC nonetheless has the statutory authority to require the transmission of geothermally-generated electric energy from the Island of Hawaii to Oahu through the cable system.

The PUC may direct public utilities which supply electricity to the public to arrange for the acquisition of and to acquire such electricity generated from non-fossil fuel sources as is available from and which the producers of same are willing and able to make available to such public utilities, and to employ and dispatch such non-fossil fuel generated electricity in a manner consistent with the availability thereof to maximize the reduction in consumption of fossil fuels in the generation of electricity to be provided to the public.[6]

Moreover, the PUC may also, under its general powers, require the transmission agreement between the cable entity and the electric utility to be submitted for its review and approval, as well as the power purchase agreement between the public utility and a geothermal energy producer.[7] Although no statute or regulation specifically addresses the concept of an independent cable system, the PUC must also approve, and could partially or wholly disallow, the passing on by HECO to its customers of the cable transmission charges and electric power purchase costs.[8]

4 H.R.S. 269-27.2(b)
5 H.R.S. 269-27.2(c)
6 H.R.S. 269-27.2(b)
7 H.R.S. 269-27.1
8 H.R.S. 269-16(b)

In summary, current State public utilities law presumes a regulatory role for the PUC in approving the contractual pricing, business terms and other conditions relating to the pricing of geothermally-generated electricity and its transmission to HECO, as well as HECO's ultimate sale of such energy to the public. The PUC would not, however, have direct regulatory authority to review the general business, financial or managerial decision-making of the geothermal energy producers or the owners and operators of the deepwater transmission cable system.

C. <u>Ownership Arrangements for the Project</u>

1. <u>Geothermal Power Production Facilities and Wells</u> As discussed earlier in Section III, several private corporate joint ventures have been actively test drilling in the Puna area on Hawaii to verify the extent of the geothermal reservoir. In addition, HELCO, has held discussions with these geothermal developers regarding purchase power contracts for up to 50 megawatts of geothermal power production, commencing in the early 1990's.

   Based upon the current level of private entity involvement in geothermal development on Hawaii; the significant amounts of capital that will be required to explore and develop 500 megawatts of geothermal power production capacity and the specialized technical and engineering expertise necessary for such a successful development effort, one or more private entities, working separately or in several joint ventures or consortia appear to be the most appropriate owners for the geothermal production capacity on Hawaii.

   This private development and ownership approach would enable a number of different companies from throughout the world to participate in the geothermal reservoir development and in electrical power plant construction and operation activities based upon a competitive selection process.

   The legal form and business relationships among the various private entities undertaking the geothermal development could be one of several organizations available to private parties, although the most likely commercial enterprises are: (1) a corporation, (2) a general or limited partnership or (3) a joint venture. Either of these entities could be formed under Hawaii law or under the laws of another jurisdiction and then qualified to do business in Hawaii.

The particular advantages and disadvantages of each of these different forms of private entities center on differing approaches to control, operational and decision-making flexibility and, most importantly, structuring of both the financing and the actual security arrangements to ensure that the private parties providing such financing are adequately protected and are ultimately repaid their investment together with a desired return on that investment. Moreover, the Federal and State income tax benefits that may be available to the private entity and in turn its equity investors will play a major part in structuring the financing approach and enhancing the attractiveness of a particular investment opportunity. Section VI discusses these issues in detail.

2. Deep Water Cable Transmission System

One of the most important conclusions reached by the Governor's Cable Advisory Board in its January 15, 1988 report to the Governor, was to view the geothermal power production facilities and the deep water cable transmission facilities as interrelated parts of an overall coordinated development effort.

It is very clear that the development of a commercial cable system cannot be examined in isolation, particularly because the costs involved and the possible financing approaches to fund those costs depend upon ensuring that a cable system will be able to assure the generation of sufficient revenues to satisfy the requirements of the financing and provide a reasonably reliable supply of electric energy to Oahu.

Equally fundamental, the purpose of a commercial cable system would be to transmit electric energy generated from the geothermal resources on the Island of Hawaii to Oahu. It would be financially infeasible to raise the required financing for a cable system and then actually to install that system without the coordinated development of the renewable alternate energy electric production facilities to provide energy to be transmitted upon completion of construction and acceptance testing of the installed cable. The private geothermal resource developers currently active on Hawaii have clearly stated that they would not undertake the substantial investment of effort and might be unable to obtain required financing to develop the geothermal resources that they have under lease without a very firm assurance that they would be able to transmit such energy to Oahu through the cable upon completion of construction of their geothermal power plants. As a consequence, it is possible that the same private companies or joint ventures that are selected by the State to act as developers and owners of the geothermal power facilities may also undertake the development and ownership of the deep water cable transmission facilities. However, it is equally possible that due to the magnitude of the construction effort, potential financial risks and the different technical and engineering expertise required for the cable system, totally separate private companies may pursue development of the transmission facilities, while on a parallel path, other private entities develop the geothermal production facilities. In either case, one of the major responsibilities of the State will be to coordinate the possibly separate private development efforts for both the geothermal production and transmission phases of the overall Project.

The legal form and business arrangements for the private entity development and ownership of the deep water cable facilities would be based upon the same corporation, partnership or joint-venture scenarios discussed above and in Section VI for the geothermal power production facilities.

D. Consolidated Permitting System for Integrated Development of the Project

1. Existing Permitting System

In 1983, the State Legislature enacted the Geothermal Resource Subzone Assessment and Designation Law (Act 296-83). [9] This law mandated the creation of "geothermal resource subzones" within which geothermal exploration and development could take place, regardless of prior land use restrictions. Under this law the State Department of Land and Natural Resources (DLNR) established geothermal resource subzones based upon a number of factors, including: (1) potential for production of geothermal energy, (2) use of geothermal energy in the area, (3) geologic hazards, (4) social and environmental impacts, (5) compatability with present permitted land uses, (6) potential economic benefits and (7) compatability with conservation policies for subzones within conservation districts.

9 H.R.S. 205-2

In November 1984, the DLNR designated three specific areas within the Kilauea Rift Zone as Geothermal Resource Subzones.

In such subzones, Hawaii County continues to have jurisdiction over site-specific activities on agricultural, urban and rural lands, while the DLNR has site-specific jurisdiction on conservation lands.

2. New Legislation for Consolidated Permitting System

In order to more closely coordinate the permitting process for the interrelated geothermal power production and deep water transmission cable portions of the Project, the Governor submitted to the State Legislature in January 1988 a bill to establish a consolidated permit application and review process (S.B. 3182, the Permit Bill). As approved by the State Legislature in April 1988, the Permit Bill designates the DLNR as the "lead agency" to establish and administer a consolidated permitting process involving the various federal, State and county agencies that must approve the construction and operation of the Project.

This consolidated permitting process is intended to promote the development and financing of the Project by private companies by coordinating the multiple State and county agency jurisdictions for approvals presently necessary for geothermal and cable development, thereby reducing the time and risk capital that may be required to permit and develop the Project. In addition, by coordinating the permitting of both the geothermal resources and the cable system in one regulatory process, the development of a single integrated Project is encouraged. The Coordinated Permit Application Review Process would include all State and county level permitting functions involved in the development of the Project and all federal agencies willing to participate and will have several components: (i) the master list of permits required for the Project; (ii) a master coordinated schedule for various permit reviews and approval deadlines for the Project; (iii) an interagency group to coordinate the permit application and review process for the Project; and (iv) a joint agreement among the members of the interagency group to be used in implementing the actual reviews and hearings for the Project for all permitting purposes.

The Permit Bill provides that DLNR shall have primary responsibility to coordinate and consolidate where possible all required permit reviews by State agencies, having jurisdiction over various aspects of the Project.

The significant elements of the permitting process are that each applicant for a permit for the development of the Project shall submit the appropriate consolidated application form, the DLNR shall thereafter notify all affected State and local agencies, as well as federal agencies, to participate in the permit application and review process. Among other things, all parties will develop and sign a joint agreement setting forth the basic procedures and guidelines to be used in this review process. Since it is not possible for the Permit Bill to mandate any action by federal agencies, appropriate provisions are included to invite affected federal agencies to participate in this review process, but applicants must also apply directly to each federal agency which does not participate in this coordinated review process.

The Permit Bill also provides for the DLNR, as the lead agency, to establish an interagency group comprised of the DLNR, those State and county agencies whose permitting functions have not been transferred to the DLNR, and, where possible, federal agencies to undertake certain permit facilitating and agency liaison functions. This interagency group will be used to ensure cooperation in coordinating the permit review process by the various agencies to the greatest extent possible.

In general terms, the Permit Bill has been designed to enable the State, through DLNR, to provide effective overall direction and coordination for the development and permitting of the Project and to encourage the greatest possible private company involvement in the actual construction, financing and operation of the Project.

E. Involvement of Private Contractors in the Project

As currently contemplated, the State (through establishment of an Authority or through an existing agency) will use its relatively broad and flexible oversight and coordination powers to enter into contractual arrangements with private third parties for the development, financing, construction and operation of the Project. As a result, the State and its legal and financial advisors will be able to negotiate with various private companies to provide equipment, construction, financing, operations or other services required to implement the Project. This type of governmental involvement is similar in basic respects to that recently employed for the organization and recent successful financing of the $10.4 billion Eurotunnel project between England and France. The Eurotunnel project proposes to build over a six-year period a 31 mile underground transportation system beneath the English Channel. In 1984, the British and French Governments revived an earlier effort dating back to 1975 to sponsor the development of such a project.

Due to the massive financial size of the proposed project, both governments rejected any notion that governmental budget funds or financial guarantees would be available for the construction funding. However, the British and French were willing to establish and fund a joint quasi-governmental entity, Eurotunnel PLC and SA, to coordinate and oversee early-stage development efforts for the project. Thereafter Eurotunnel proceeded for the next two years with necessary technical reviews for the project and governmental approvals for construction and operation.

In addition, Eurotunnel concurrently solicited proposals from various private construction companies to oversee the design, engineering and construction of the project and developed with its financial advisor an economic feasibility analysis and overall financing plan that could be satisfied by the Eurotunnel's expected economic projections.

This four-year development effort by Eurotunnel and its advisors was culminated during 1987 with two significant milestones:

(1) the negotiation and signing of a $9 billion loan package with a large consortium of international banks and (2) the interviewing and selection of a group of securities underwriters who sold $1.4 billion of stock in Eurotunnel to the public. Construction work on the project commenced at the end of 1987.

The practical implementation of the Project, will necessitate a similar public sponsored and controlled development approach, utilizing private company contractors and relying principally upon private sector financing sources negotiated by the State and its advisors on a "project-recourse" basis.

VI. ANTICIPATED PROJECT FINANCING ARRANGEMENTS

A. Assessment of Major Project-Related Risks

In order to develop the most appropriate overall financing plan for the Project, it is first necessary to analyze the nature and extent of various risk factors inherent in the development, construction and operation of the Project.

Potential investors providing debt or equity financing for the Project are particularly concerned with any risk that may delay or prevent the completion of the Project or reduce the net revenues generated from the completed Project. The following are the key Project risks of concern to lenders and investors in terms of both the Project's lifecycle phases and its operational characteristics:

1. Project Financing Risk Periods. Different financing credit risks will occur at different times in the course of the Project's construction and operation. These fall into three periods: (i) the engineering and construction phase; (ii) the start-up phase; and (iii) the operational phase. Different guarantees and undertakings provided by different private contract participants must be used in each phase to provide the credit support necessary for structuring a project financing.

    a. Engineering and Construction Phase. The Project will probably require at least a five-to-seven year period of technical and engineering work, equipment ordering and actual construction. Therefore, the dollar amount at risk begins to increase sharply as funds are advanced to purchase material, labor and equipment. In addition, interest charges on loans to finance construction compound and accrue during this time. The major risks here include cost-overruns, delays in completion and even possible non-completion of construction.

    b. Start-Up Phase. Investors will not regard the Project as completed on conclusion of construction of the facility. They remain concerned that the Project will operate and will do so at the costs and in accordance with the operational specifications that were originally planned and used as the basis for projected economic forecasts. The Project's failure to produce and transmit electricity in the amounts and at the costs originally planned will adversely affect the Project's economic feasibility and may result in insufficient revenues to service debt and pay expenses. The Project's investors will regard the Project as successful only after it has operated for a sufficient period of time at an operating level and with costs similar to those assumed in the financial projections which formed the basis for the financing. This start-up risk phase may last from a few months to a year, depending upon the lenders' risk assessment of the technology utilized by the Project.

c. Operational Phase. Once the investors are satisfied that the Project facilities are performing according to specification, the final operational phase starts. During this phase, the Project will operate as a regular company. If the original financial projections were correctly done, then the Project's revenues should be sufficient to service debt, pay operating costs and provide a sufficient return on investment to the private company sponsors and investors.

2. Specific Project Financing Risks. During the various risk periods discussed above, there are several specific project financing risks that are inherent in the Project's characteristics. Many of these risks can be mitigated by careful financial planning and negotiation of contracts to allocate responsibility for specific risks among the private participants in development, construction and ownership of the Project.

a. Market and Price Risks. The only source of revenues that the Project can generate are those derived from the production and sale of the electrical output resulting from operation of the Project. As a result, there must be an assured purchaser and a methodology or formula for determining the electrical price at which the output will be sold over the length of time necessary to repay the lenders and investors in the Project.

As applied specifically to the Project, it would be necessary to negotiate a "take-if-produced, cost-of-service" agreement, whereby all of the actual costs of producing and transmitting electric energy from the Island of Hawaii to Oahu could be recovered through a charge per kilowatt/hour of electric energy actually transmitted. This type of arrangement requires that the risk of non-production by the geothermal power generation facilities be borne by the builders and owners through separate contractual arrangements and likewise, that the risks relating to the performance of the transmission cable system be shared between its builders and owners.

b. Geothermal Resource Availability Risks. The supply of the reservoirs to be used by the Project to generate its electricity must be more than sufficient to ensure successful operation for the duration of the project financing and beyond. In addition, those resources must be available at a cost consistent with the Project's financial projections used as the basis for the financing.

Long-term "supply-or-pay" or "put-or-pay" contracts, can be used in which the geothermal drilling joint ventures would agree to provide the thermal energy at certain prices (with appropriate escalation) over a period of time to the operators of the power production facilities.

The long-term availability of a sufficient geothermal reservoir and the operating reliability of the geothermal power plants will be crucial to the economic competitiveness of the electric energy transmitted to Oahu and the resulting financial viability of the Project. The availability of geothermal resources with sufficient margins of reserves can be estimated with a reasonable degree of accuracy through a coordinated program of geological, geochemical and geophysical testing and exploratory drilling. The reliability of the geothermal power plants can be judged based upon the operating experience of similarly designed technologies utilizing similar types of geothermal resources in California and elsewhere in the world. Finally, the performance warranties and/or production guarantees negotiated with the private design and construction contractors for the geothermal power plants by the State and its financial and legal advisors will be a crucial factor in structuring the financing plan for the Project.

c. Technological Risks. One of the most challenging issues in designing a financing plan for the Project will be the respective technologies used both to produce geothermal electric energy and transmit that energy to Oahu.

The construction of the electrical production and transmission phases of the Project must be pursuant to "turnkey" construction contracts. Under such contracts, individual full-service prime contractors would assume the responsibility for completing construction of specified major components of the Project for a maximum price, within a specified period of time and subject to fulfilling specific testing procedures and operational performance criteria for the Project once it is energized. The prime contractors would not be relieved from their responsibilities under these contracts until these performance "acceptance" tests have been successfully met during the start-up phase.

d. Insurance Coverage for Risks. Certain risks associated with the development, construction and operation of the Project, are not easily foreseeable or controllable through contract allocations. Some of these "force majeure" types of risks can, however, be mitigated through a well-designed insurance risk management program. An adequate insurance program must encompass both the construction and operational phases of the Project, covering the replacement costs of major Project facilities or components.

The Project's initial and on-going insurance requirements must be evaluated at the outset and reviewed and updated periodically. Insurance coverage during operations should in particular include "business interruption insurance" to provide protection against the possibility that the Project cannot be operated for certain periods of time for certain specified and identifiable causes. This insurance would provide funds both for repairs or replacements of Project components and to meet Project operational and financing expenses during the repairs or replacement work.

B. Contractual Arrangements for Risk Mitigation and Allocation

The contractual arrangements referred to above seek to minimize the financial impact of certain risks that will be inherent in the construction or operational phases of the Project. These risk mitigation arrangements will enhance the ability of the Project to meet its financial obligations to investors on a truly "stand-alone" basis. In actual negotiations by the State, some of these risks may not be properly or fully mitigated by contractual agreements with the private builders and operators of Project facilities.

However, the objective in negotiating the contractual arrangements for the Project will be to package and combine the risk undertakings of various private company participants in such a way that the overall credit responsibility for the Project is allocated among the participants instead of assumed by a single party and allocated in a manner acceptable to both the private contractors as well as the State and the Project's equity investors. The techniques that can be used to mitigate and allocate the Project's major risks are diverse and are limited only by the ingenuity of the State and its legal and financial advisors and their acceptability to the private contractors and investors. The key principle in these often complex and difficult contractual negotiations will be to eliminate or greatly mitigate various Project-related risks or if not mitigated, to allocate these risks among the private participants on the basis of: (1) the participant best able to influence specific risks and/or (2) the participant best able to bear some portion of the financial impact of specific risks if they occur, in spite of various mitigation efforts.

As discussed in Section VI.A. in relation to specific risks of the Project, the single most important set of contracts will be those relating to the design, construction and operating performance of the geothermal power plants and the transmission cable.

The expertise and reputation of the private contractors that construct the Project facilities must be well-established. The contractors must have sufficient technical expertise to complete the Project so that it will operate in accordance with cost and production specifications. Ideally, the designer and the construction contractor for the geothermal power plants should have previously successfully designed and built similar projects, elsewhere in the world. Similarly, the cable fabrication and laying process should be the responsibility of a contractor with previous successful submarine electrical transmission experience. These contractors must be financially strong, since the financial failure of a contractor over the five-to-seven year period of work could jeopardize the completion and economic viability of the Project. In addition, the contractors must be large enough to have the financial and managerial resources to devote to and resolve any problems which might arise, given the projected financial scale of the Project.

A "prime" contract, issued on a "turn-key" basis, should not be awarded on the basis of a low bid unless the low bidder is willing to assume specifically identified financial risks relating to the cost and timing of Project construction and the operational performance of the Project following completion.

Given the size of the Project, it is possible that major portions of the Project may be built under separate turnkey contracts with different private contractors or contractor joint venture companies. In this case, it will be important for the State to negotiate these separate contracts in such a manner that the interrelationships between portions of the Project are properly recognized and so that the overall Project risks are properly addressed by these contracts, when viewed together.

In specific terms, these turnkey contracts should provide for: (1) completion guarantees for the Project at fixed prices or not-to-exceed prices; (2) specified time schedules for completion of certain portions of the Project and the Project as a whole; and (3) agreed-upon criteria for operating performance and costs of the completed Project and specified testing procedures and time periods over which the Project must operate as guaranteed to demonstrate acceptable performance.

Related to these undertakings in the turnkey contracts will be specified "liquidated damage" payments by the contractors that are intended to: (1) repair or replace any portion of the Project not operating as required and (2) meet Project operating and financing expenses while the Project does not meet its required operational performance.

C. Sources of Funding for the Geothermal Power Production and Transmission Facilities

As discussed in Section V.C., it appears that the most likely investors in both the geothermal power production facilities and the transmission cable system will be private companies, which may include various construction contractors, equipment vendors, geothermal resource developers, financial institutions and/or industrial corporations.

The following discussion describes the general financing approach that is most likely to be used by private owners to finance the development and construction of the Project. It assumes that the financing approach will be that of a project financing as described in Section VI.B. above.

In general, the private entity financing approach would involve a combination of (i) an investment by the private entity itself, (ii) long-term debt in the form of either taxable interest rate loans obtained from institutional lenders (e.g., commercial banks, insurance companies and major pension funds) and/or long-term debt in the form of tax-exempt interest rate bonds.

This financing plan sets forth the basic characteristics of and requirements for these principal sources of capital, and the necessary types of security arrangements. This financing plan must necessarily be adjusted to reflect the specific construction costs of the Project as they are finally determined through competitive negotiations by the State and its advisors with equipment vendors and contractors, as well as the interest rates and rates of return on equity required to market the equity investments and the debt financing when these funds are actually raised in the international capital markets.

1. Equity Investment. In financing the Project, the private owners would generally be required to provide as its investment in the project an amount equal to at least twenty percent of the construction costs. This would be true regardless of whether the private entity were a corporation, a partnership or joint venture (See Section V.C.). The actual percentage that would be required for the equity investment would ultimately be determined by the projected net operating revenues of the cable system, the relative amounts of debt service coverage margins and the expected rate of return on equity required by the investors. The ways in which this equity investment could be invested are:

   a. Direct Capital Contributions. The private owners could simply contribute the required project equity amount directly from its own funds. This is clearly the most straightforward approach but it does impact adversely on the owners' cash reserves and cash flows. Alternatively, the private owners could borrow these funds and then contribute them to the Project. This, however, incurs a separate debt obligation, which must eventually be repaid together with interest on the borrowed principal. This could similarly adversely affect the owners' cash flows and general credit rating.

   b. Leveraged Lease Financing. Leasing in general and leveraged leasing in particular are methods of private ownership financing that are often used in a project financing. In a lease financing, the operators of the Project assets leases the assets from a financial institution as "owner-lessor" rather than owning the asset and financing its development and acquisition through direct borrowings. If the lessor, as an equity investor and the legal owner of the asset, has borrowed some of the funds to pay for the asset, the financing is a leveraged lease financing.

      In a leveraged lease financing, the equity investors normally acquire the project facility or asset to be leased through a special purpose ownership trust.

The equity investors contribute to the trust a portion of the funds (normally at least 20%) necessary to construct the asset. The trust in turn obtains the remaining funds needed to purchase the asset through the sale of its long-term debt obligations. Once these funds have been obtained, the trust then purchases the asset and in turn leases it to a project entity (which has been formed by the operators-sponsors). The project entity takes possession of and operates the asset and derives the revenues from the operations. The debt financing, which is usually with limited or no recourse to the owner-lessor is secured by a first mortgage on the Project in favor of the lenders (i.e., the purchasers of the trust's long-term debt obligations) and an assignment to such lenders of the lease and all lease rental payments. The lenders look mainly to the lease rental payments made from operating revenues for repayment of the borrowed debt.

The owner-lessor's return on equity investment is derived from (i) the net cash flow available from the lease rental payments in excess of debt service obligations, (ii) any tax benefits of ownership (primarily, depreciation deductions and interest deductions on the non-recourse debt leverage under current Federal income tax laws), and (iii) the residual value of ownership, and/or the net amount realized upon the disposition, of the assets. The lenders providing the non-recourse debt portion of the financing look primarily to the ability of the Project contractual arrangements as discussed in Section VI B to provide reasonable assurance of sufficient operating revenues to make timely rental payments and only secondarily to the collateral value of the leased assets.

Equity participants are usually one or more commercial banks, bank affiliates, leasing companies or finance companies which acquire title to the cable system, initially to obtain the tax benefits of ownership and to realize an additional return from the annual lease payments and subsequent sale or disposition of the Project.

2. Taxable Interest Rate Loan Financing. The private owners would obtain most of the funds needed to construct the Project (up to eighty percent) through taxable interest rate loans or tax exempt interest rate bonds or a combination of the two. This subsection will discuss

taxable interest rate loan financing, and Subsection 3. below will discuss tax-exempt interest rate bond financing.

Taxable interest rate loan financing is generally obtained from major institutional lenders such as banks, insurance companies and major pension plans. Historically, commercial banks have been the single most active source of debt for large project financings, such as the Project. As a general rule, banks prefer to limit their lending commitments to the period encompassing the construction phase and eight to twelve years of loan amortization following completion of construction, with floating interest rates pegged to the U.S. Prime Rate, the cost of certificate of deposit borrowings by the banks or the London Interbank Lending Rate (LIBOR). For projects of the cable system's magnitude it is typical for a group of banks to form a syndicate to provide the lending commitment.

The major advantages of the syndicated loan are that (i) large amounts of debt financing can be raised, since the syndicated loan market is the largest source of international capital; and (ii) banks participating in syndicated loans are able to deal with the complex credit risks inherent in major project financings, such as the Project. A syndicated loan for the Project would be negotiated by the State and its advisors with a small number of "agent banks" acting as lead managers and co-managers. The essential loan documentation consists of the loan agreement, promissory notes and security documents, although there are usually a host of ancillary documents involved, including the Project-related security arrangements and contracts.

Some of the basic provisions in the loan agreement include: the amount which may be borrowed; the term of the loan and repayment schedule; the applicable interest rate; procedures and conditions precedent for take-downs of the funds loaned; representations and warranties of the borrower (including use of proceeds, financial conditions and title to assets); affirmative covenants (such as compliance with laws, obtaining requisite government approval, maintenance of insurance and limitations on mergers, dividends; and sale of assets); financial covenants (such as limitations on additional indebtedness and maintenance of financial debt service coverage ratios); responsibility for any withholding tax on interest; and remedies in case of default and cross-default clauses.

There are currently a significant number of U.S. and foreign commercial banks with the required lending capacity, project finance expertise and interest in lending to a facilities such as the Project, assuming that the contractual arrangements are well-structured for a non-recourse or a limited recourse project financing.

Institutional lenders, principally life insurance companies and major pension funds, are also active sources of project financing. In contrast to commercial banks, these institutional lenders typically prefer not to provide construction period loans, thereby avoiding the risks associated with construction and the initial commencement of project operations. However, they will provide take-out or permanent financing on a fixed interest rate basis for periods of up to twenty years amortization, allowing the private owners to repay over a longer period of time the amount borrowed to cover the capital costs of the Project. This in turn would enable the private owners to minimize the charges that it must impose for the sale of electric energy generated and transmitted by the Project.

The lending commitments of both commercial banks and institutional lenders are normally arranged as a negotiated "private placement" transaction. In contrast to "public offerings", private placements do not require Federal or State regulatory approval or public disclosure and are normally arranged with a limited number of substantial and sophisticated institutions. As a result, these private placements do not require the filing of registration statements with the U.S. Securities and Exchange Commission under Federal securities law or any State securities commission under applicable state laws. A private placement also allows the specific terms and conditions of the lending arrangements to be tailored to the unique economics of a complex situation, such as the Project, through direct negotiations between the Authority and its advisors and the lenders.

3. Tax-Exempt Interest Rate Bond Financing. Along with or in place of taxable interest rate debt, another financing source that is available to the private owners involves industrial development revenue bonds (IDBs). Section 103 of the Internal Revenue Code of 1954 (the Code) provides that the interest earned by a purchaser of bonds issued by a state or municipality will be tax-exempt, provided that the bond issue complies with the requirements of that Section and the regulations adopted thereunder.

   a. Section 103(b)(4)(E) of the Code, provides that interest on a bond issue will be tax-exempt if substantially all of the proceeds are to be used to provide "facilities for the local furnishing of electric energy or gas", which include land or depreciable property which is used in the trade or business of furnishing electric energy or gas to produce, collect, generate, transmit, store, distribute or convey electric energy or gas and which is part of a system providing service to the general populace of one or more communities or municipalities, but in no event more than two contiguous counties (or the political equivalent thereof) or not more than one city and a contiguous county (the "two county rule").

A facility for the local furnishing of electric energy will be deemed to be an exempt facility only if it must serve, or be available on a regular basis for use by, the general public (the "public use" test). A facility will meet this public use test if its owner or operator is obligated by law, regulation or the equivalent thereof to serve all persons in the service area who desire service and if the facility is reasonably expected to serve, or be available to, a large segment of the general public in the service area.

The distribution on Oahu by HECO of the geothermal energy transmitted through the cable system should satisfy this "public use" test when HECO purchases the cable-transmitted electric energy for distribution to its customers, because the ultimate recipients of the electric energy will be the general public.

The Project, as currently contemplated, will also satisfy the "two county" limitation as long as the electric energy transmitted by the cable system is distributed only to users within no more than two counties, i.e., the County of Maui and the City and County of Honolulu.

b. Volume Limitations on IDB Financing. There is a potentially more serious limitation to the use of tax-exempt bonds to finance the Project. The total amount of all IDBs that can be issued annually within each state is also limited by Section 103 of the Code. The amount of tax-exempt IDBs that can be issued within Hawaii during any one calendar year is limited to the greater of $50 per resident or $150 million. To satisfy this limitation for the Project costing $2.0 billion or more tax-exempt IDBs would need to be issued over ten or more calendar years. Such an extended construction and financing period may not be economically viable, due to the increased amount of interest charges that would accrue prior to the full operation of the Project.

This extended time period, may or may not also accommodate the most appropriate construction schedule for the Project from an engineering viewpoint. In addition, without specific Congressional action to amend this limitation for the Project in Section 103 of the Code, it may not be deemed appropriate within Hawaii for all of the private IDB volume to be dedicated to the Project, in light of other potential uses for IDBs.

c. IDB Financing Under Hawaii Law. Pursuant to H.R.S. Chapter 39A, Part VI, Special Purpose Revenue Bonds (SPRBs) -- which are tax-exempt IDBs under Section 103 of the Code -- may be issued through the State Department of Budget and Finance (B&F) to assist regulated utilities serving the general public in providing electric energy under the "two county rule". However, as discussed in Section V.B., the private owners of geothermal power production or transmission facilities are not deemed to be a regulated utility and thus would not qualify for SPRB financing under H.R.S. Chapter 39A, Part VI absent a special amendment to that statute by the Legislature.

The SPRBs for a specific project must be authorized by an affirmative vote of two-thirds of the members of each House of the State Legislature. These SPRBs are issued pursuant to a project agreement between B&F and the borrower which obligates the borrower to pledge specified revenue sources to pay the SPRB principal and interest pursuant to a secured financing arrangement. The bonds are payable only from the revenues received by B&F pledged by the borrower and are not a general obligation of the State, and neither the State's taxing power nor other State revenues may be pledged as security for payment of these bonds. The bonds and the interest earned thereon are exempt from all State and County taxes except inheritance, transfer and estate taxes.

d. Financeable Costs. IRS Regulations 1.103-8(a)(3) defines an exempt facility (such as "two county" facilities) to include any property functionally related and subordinate to the facilities. Costs of "two county" facilities which may be financed with tax-exempt bonds include the cost of the facilities themselves, interest during construction, and expenditures for financing, legal, printing and other fees connected with the issuance of the bonds up to a limit of two percent of the amount of bonds issued.

4. Foreign Government Export Credit Financing. Foreign governmental export credits, if available, could provide an additional portion of taxable interest rate debt financing for major items of equipment and/or other goods and services provided for the Project by non-U.S. manufacturers and equipment vendors.

   The governments of most countries with major equipment manufacturing and supply firms provide export credit support to encourage export sales of such major equipment and ancillary goods and/or services, thereby increasing that country's national income from foreign trade. This export credit support is furnished through diverse ways, including direct loans, guarantees or interest rate subsidies on private lender borrowings. Some examples of major institutions providing such support include the U.S. Export-Import Bank; the Japanese Export-Import Bank; the UK Export Credits Guarantee Department (ECGD); the Banque Francaise du Commerce Exterieur (BFCE) and Compagnie Francaise d'Assurance pour le Commerce Exterieur (COFACE) in France; the Canadian Export Development Corporation; the Ausfuhrkredit Gesellschaft (AKA); Kreditanstalt fur Wiederaufbau (KFW); Deutsche Revisions, Trehand AG and Hermes Kreditversicherung AG (a private company) in West Germany; and AB Svensk Exportkredit in Sweden.

   Each government (and even agencies within the same government) differs in its requirements for the types of contractual arrangements and the resulting financial security for repayment promised by the private entity before it will grant an export credit. Some governments, for example, are reluctant to extend export credits on a non-recourse or project financing basis, while others have no hesitancy in doing so. However, export credit agencies are generally willing to negotiate such support in a limited recourse project financing situation, if properly structured from a contract security viewpoint.

   The main advantages of export credit financing are that it is normally at fixed and often subsidized interest rates, and the repayment of these export credit loans can usually be deferred until the project for which the equipment is being financed has operated for an initial grace period. The main disadvantages of export credits are that they would normally apply only to a specified percentage (70% to 90%) of the direct costs of specific items of equipment manufactured in the foreign country and exported for use in the project, the repayment of these loans normally is relatively short-term (5 to 7 years) after the initial grace period, and, of course, the procurement of the equipment involved is tied to the country providing the export credits.

The availability of export credit financing for the Project will depend upon the extent to which foreign-manufactured equipment is chosen by the State in its competitive negotiations with equipment suppliers and contractors.

D. Contract Security Relationships Between Geothermal Power Production and Transmission Facilities

As discussed in Section VI A. and B., it is possible that different private parties may act as owners and/or prime contractors for the geothermal power production and deep water cable portions of the Project, given the magnitude of Project costs and differing nature of technical risks involved. In such a case, it will be extremely important that the interrelated nature of these two portions of the Project be properly addressed in the risk allocation contract negotiations.

For example, in negotiating the separate turnkey construction contracts for the Project, each contractor should be held financially accountable not only for delays in completing its own scope of work, but also for any delays in the work of other contractors that is caused or influenced by its delayed performance. Allocating risk and responsibility for these types of interrelations can often be complex and difficult to clearly isolate.

In addition to construction period interactions, Project operational performance risk and responsibility among different parties must also be allocated in a mutually satisfactory manner. For example, it would be necessary to assign financial liability to the geothermal resource developers if the necessary quantity and quality of steam is not provided to generate and transmit the anticipated quantities of electricity to Oahu. Likewise, the financial costs of the Project would be contractually charged through liquidated damage clauses to the geothermal power generation plant owners if they cannot produce the necessary quantities of electricity even though the geothermal steam is available and the transmission cable operable. Similar performance liquidated damages would be assessed against any separate private owners of the transmission cable system if they could not transmit available quantities of electricity production to Oahu.

As during the construction phase of the Project, allocating the risks and responsibilities for various potential interrelated operating failures would require extremely complex and difficult negotiations between the State, its legal and financial advisors and various private contractors, owners and their respective advisors.

However, carefully negotiating these risk allocations and liquidated damage penalties to provide reasonable levels of financial security to lenders and equity investors, will be the key to any successful financing plan for the Project.

VII. OPERATIONAL ARRANGEMENTS FOR THE PROJECT

A. Discussion of Operational Responsibilities

Along with the various construction period risks that must be mitigated through the contractual arrangements discussed in Section VI.B. and E., there are various operational period risks that must also be addressed. Investors in a non-recourse financing for the Project will insist that either the Project's sponsors or other parties as operators under long-term contracts possess the technical expertise to operate and maintain the Project and the experience in operating similar power generation and/or transmission facilities. Such operations and maintenance contracts should condition the payment of certain bonuses to, and impose penalties for substandard performance on, the operating contractors, based upon the actual performance levels achieved by the Project and the ability of the Project's revenues to meet all financial and operational costs.

In addition, good management and administrative personnel as well as experienced operating personnel will be needed to successfully implement the Project. The general management of the Project company makes the basic policy decisions and is responsible for monitoring and administering the Project entity.

It is likely that the prime "turnkey" contractors who design and build either the geothermal power generation or cable transmission portions of the Project will also offer operations and maintenance services by contract, at least for the initial period of the performance warranties and liquidated damages under the construction contracts. These builders would not want to pay damages for substandard performance of the Project as a result of poor operations or maintenance practices by other parties following the construction period.

Obviously, the major concern of both lenders and investors in the Project, as well as the State, will be to enhance the long-term reliability and economic viability of the geothermally- produced electricity transmitted to Oahu as a result of the terms of the contractual operations and maintenance requirements and expertise of the parties performing these requirements.

B. Involvement of HECO with the Project

As outlined above, it is likely that the operation of the Project's geothermal power production and cable transmission facilities will be undertaken by various private parties, as owners, turnkey builders and/or long-term contract operators. In this case, HECO's likely role would be to coordinate and facilitate the integration of the geothermal electricity produced and transmitted from the Project, with the varying daily and seasonal fluctuations in power demands on Oahu. Electrical grid system issues that must be addressed in conjunction with HECO include the amount of required spinning reserves, maintenance of short-circuit levels, any modifications of current must-run units on Oahu to cycling units and back-up supply for loss or major blocks of transmitted geothermal power.

In addition, the load and generation characteristics at the HECO end of the system on Oahu will define the required operating characteristics of the geothermal generation facilities. Conflicts between generating requirements at both the Hawaii and Oahu ends of the Project will need to be identified before significant detailed design of the geothermal units, cable transmission system and the on-shore transformation and interconnection substations.

Once the Project is interconnected to the HECO grid on Oahu and energized, HECO personnel are also best suited to coordinate the dispatching and cycling of the electric capacity from the Project with changes in power supplies and demands on Oahu. Finally, HECO may also be best suited to provide contract maintenance services for the on-shore cable system facilities that interconnect with the existing HECO distribution grid system and possibly the undersea transmission cables.

C. Project Power Purchase Agreement Terms with HECO

As discussed in Section V.B. above, the PUC is anticipated to maintain its existing regulatory authority over the pricing and other business terms of HECO's purchase of geothermal electricity from the Project. The actual parties to the power sales agreement with HECO will be influenced by the ownership arrangements for the Project. Specifically, if the geothermal power generation plants and the transmission cable are owned by separate private parties, the geothermal producers may contract with HECO to purchase power delivered on Oahu and separately with the private owners of the transmission cable for transmission services to deliver the power from Hawaii to Oahu.

Alternatively, if both portions of the Project are owned by one private entity or ownership group (such as a partnership or joint venture) there would only need to be the single power sales agreement with HECO.

In either case, the price ultimately paid by HECO for delivered power will have to be determined in such a manner to provide reasonable assurances to private lenders and investors in the Project that the actual costs of geothermal power generation and transmission will be recovered.

As discussed in Section VI.A and B. above, a probable power pricing methodology would be a "take-if-produced, cost-of-service" agreement whereby the actual costs of producing and transmitting Project power would be recovered through a charge per kilowatt/hour of electricity delivered to HECO on Oahu. Such a power sales contract between the Project and HECO would, of course, be subject to the PUC's review and approval of its terms.

VIII. PROJECT ECONOMIC AND FINANCIAL PROFORMAS

The purpose of this Section is to provide a realistic projection of major economic and financial variables that will influence the feasibility of the Project, in terms of both its attractiveness to private investors, as well as the price of geothermal electricity delivered to Oahu. At the present stage of development and engineering for various aspects of the Project, this projection will indicate whether additional work is justified to confirm and validate the actual costs of implementing the Project. As a result, the actual costs of the final Project may differ significantly from those projected in this Section.

A. Major Project Assumptions Used in the Projections

1. Project Generating Capacity:

- Gross	550 Megawatts (MWs)
- Net of Line Losses	500 MWs

2. Construction Period and Schedule of Generating Net Capacity On-Line Dates:

- Start	25 MWs in 1995
	75 MWs in 1996
	150 MWs in 1998
	200 MWs in 1999
	250 MWs in 2000
	275 MWs in 2001
	325 MWs in 2002
	375 MWs in 2003
	400 MWs in 2004
	450 MWs in 2005
- Completion	500 MWs in 2006

3. Project Construction Cost Components (1986 $s) [10]

Transmission System

a. HVDC Converter Station	$ 73 million
b. On-shore Transmission Cable	83 million

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10 Based upon cost estimates developed by Power Technologies, Inc., Hawaiian Electric Company, Puna Geothermal Venture and True/Mid-Pacific Geothermal Venture for the HDWC Program and Decision Analysts Hawaii, Inc.

c.	Deep Water Cable Manufacture	187 million
d.	Deep Water Cable Transport & Deployment	41 million
e.	Oahu Distribution Grid Modifications	24 million
f.	HVDC Design & Engineering Services	22 million
	Subtotal	$ 430 million

Geothermal Wells and Power Plants

a.	Well Testing and Development Drilling	$ 600 million
b.	Steam Gathering Pipelines	108 million
c.	500 MW Geothermal Generation Plants	555 million
	Subtotal	$1,263 million

Total Project Construction Costs	$1,693 million
Plus: Project Cost Escalation Contingency - 10%	169 million
Total Project Construction Costs	$1,862 million

4. Project Financing Plan and Sources

Debt to Equity Ratio	80%/20%
Debt Term	25 years
Debt Interest Rate - Fixed	10%
Minimum Required Debt Coverage Ratio - Annual	1.25 times

PROJECT COSTS
($000,000 omitted)

Turnkey Construction Price-Geothermal ('86 $s) Power Production & Transmission-est.		$1,693
Cost Esc. & Contingency	10%	169
Debt Service Reserve		0
Net Interest during Construction (1)		717

Net Project Cost		$2,579
Closing Costs & Financing Fees (est.)-1% of Cost		26

AMOUNT TO BE FINANCED		$2,605
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(1) See Construction Draw Schedule for estimate.

CONSTRUCTION DRAW SCHEDULE:

Year:	Construction Funding Draws	Construction Debt-80%	Private Equity-20%	Interest on Construction Debt (2)	Interest on Construction Interest (2)	Tax Benefits (ITC + ETC)	Cummulative Const. Loan Draws (Const. & Acrd. Int.)
1 Jan. 1990	28	22	6				22
2	3	4	1	2	0		27
3	59	49	12	2	0		76
4	171	142	35	6	0		218
5	178	158	40	19	1		376
6 1995	119	121	30	30	2		497
7	226	213	53	36	5		710
8	163	173	43	45	8		883
9	108	138	34	53	12		1,021
10	208	221	55	52	16		1,242
11 2000	142	172	43	53	21		1,415
12	110	152	38	54	25	0	1,566
13	128	163	41	47	30		1,730
14	124	156	39	37	34		1,886
15	65	107	27	32	37		1,993
16	51	86	21	17	40		2,079
17 May 2006	7	5	2	0	0		2,084
18	0	0	0	0	0		0
19	0	0	0	0	0		0
20	0	0	0	0	0		0
21	0	0	0	0	0		0
22	0	0	0	0	0		0
23	0	0	0	0	0		0
24	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0
TOTAL	1,888	2,084	521	485	232	0	

(2) See Operating Statement Assumptions for interest rate.

Cumm. Outstand Debt-Long Term	Incremental & Cumm. L.T. Annual Debt Service		Cumm. Construction Expenditures
	Increment	Cummulative	
0			$2
0			$5
0			$65
0			$235
0			$413
25	2.74	2.74	$532
107	9.00	11.74	$758
221	12.59	24.33	$921
306	9.42	33.75	$1,028
497	21.00	54.75	$1,236
707	23.19	77.94	$1,378
862	16.98	94.91	$1,488
1,124	28.95	123.87	$1,616
1,414	31.94	155.81	$1,740
1,594	19.83	175.64	$1,805
1,871	30.47	206.11	$1,856
$2,084	23.48	229.59	$1,862
0			
0			
0			
0			
0			
0			
0			
0			

(2) See Operating Statement Assumptions for interest rate.

OPERATING STATEMENT ASSUMPTIONS

CONSTRUCTION PERIOD ASSUMPTIONS:

Total Construction Cost =	$2,605
Construction Period in Years =	16
Avg. Construction Period Interest=	8.5% LIBOR-based rate

INFLATION RATE ASSUMPTIONS:

General Operating Costs Inflation=	4.5%
Insurance Inflation Rate =	4.5%

EXPENSES:

Property Tax (% of Cost)	1.00%

OPERATING ASSUMPTIONS:

Total Annual Power Production (MWhs/Yr) =	4,161,000
Installed Capacity-Net of Line Losses (MWs) =	500
Average Annual Project Availability =	95%

TAX ASSUMPTIONS:

Investment Tax Credit	0%
Energy Tax Credit-Geothermal	0%
Investment Tax Credit	$0
Energy Tax Credit	$0
Total Tax Credits	$0

Federal Tax Basis for Deductions:

Depletion Allowance-Annual Well Expenditure	$914
5 Year 200% Declining Balance Depreciation	$1,665
25 Year Straight Line Basis	$26
Tax Rate-State =	6%
Tax Rate-Federal =	34%

LONG TERM DEBT ASSUMPTIONS:

Long Term Interest Rate =	10.0%(3)
Term of Debt (Yrs)	25
Debt/Equity Percentage =	20% Equity

(3) U.S. Treasury Bond-based rate.

Long Term Debt	$2,084
Initial Equity Investment	$521
Total Project Cost	$2,605

CASH FLOW OPERATING PROJECTIONS

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
REVENUES:(4)														
Electricity Sales	$18	$40	$68	$89	$129	$202	$236	$290	$363	$403	$463	$514	$522	$530
Total Revenues	$18	$40	$68	$89	$129	$202	$236	$290	$363	$403	$463	$514	$522	$530
EXPENSES:(5)														
Operations & Maintenance-(Transmission)	$1	$1	$1	$2	$2	$2	$3	$3	$3	$3	$4	$4	$4	$4
Property Insurance-(.5% of Property Value)	2	$4	$5	$5	$6	$7	$8	$8	$9	$9	$10	$10	$10	$11
Operations & Maintenance-(Well Fields)	1	$3	$6	$7	$10	$13	$15	$19	$22	$25	$29	$34	$36	$37
Operations & Maintenance-(Power Plants)	2	$6	$11	$14	$19	$25	$29	$36	$43	$48	$57	$66	$69	$72
General & Administration Expenses	1	1	1	1	2	2	2	2	2	2	2	2	2	2
Property & Excise Taxes-(1% and 4%)	6	9	12	14	18	22	24	28	32	34	37	39	39	40
Well Replacement Exp.-$15M in '86 w/4.5% yr. esc.)	0	$0	$0	$0	$0	$28	$29	$31	$32	$33	$35	$36	$38	$40
State & Landowner Lease Payments (3% of revenues for yrs. 1-8; 7% thereafter)	1	1	2	3	4	6	7	9	25	28	32	36	37	37
Total Operating Expenses	$14	$25	$38	$45	$60	$105	$117	$135	$169	$184	$206	$227	$235	$243
Operating Profit	$4	$15	$30	$43	$68	$97	$119	$155	$195	$220	$258	$287	$287	$287
Debt Service-Annual	3	12	24	34	55	78	95	124	156	176	206	230	230	230
Debt Reserve Fund														
Net Cash Flow from Operations	$1	$3	$6	$9	$14	$19	$24	$31	$39	$44	$52	$57	$57	$57
Net Cash Flow for Distrib.	$1	$3	$6	$9	$14	$19	$24	$31	$39	$44	$52	$57	$57	$57
Debt Service Coverage Ratio	1.33	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Average Price Per KWH Delivered-cents (6)	$0.0848	$0.0641	$0.0657	$0.0709	$0.0775	$0.0973	$0.1030	$0.1073	$0.1164	$0.1211	$0.1237	$0.1236	$0.1254	$0.1274
Est. of HECO Avoided Costs Per KWH-cents(7)	$0.0837	$0.0931	$0.1007	$0.1077	$0.1140	$0.1180	$0.1222	$0.1280	$0.1325	$0.1372	$0.1421	$0.1472	$0.1527	$0.1589

(4) Revenues determined by operating expenses plus minimum debt service coverage margin.
(5) Operating expenses based upon estimates of 1986 costs, with esclation to 1995.
(6) Due to rounding of expenses to nearest million actual 1995 price per KWH would be lower than indicated.
(7) Estimates prepared for DBED by Decision Analysts Hawaii, Inc. in 1986 dollars' with esclation to nominal dollars at 4.5% per annum.

2009	2010	2011	2012	2013	2014	2015
*****	*****	*****	*****	*****	*****	*****
$538	$547	$556	$566	$576	$586	$593
-------	-------	-------	-------	-------	-------	-------
$538	$547	$556	$566	$576	$586	$593
$4	$4	$5	$5	$5	$5	$6
$11	$12	$12	$13	$13	$14	$14
$39	$41	$42	$44	$46	$48	$51
$75	$79	$82	$86	$90	$94	$98
2	3	3	3	3	3	3
40	41	41	41	42	42	42
$42	$43	$45	$47	$50	$52	$54
38	38	39	40	40	41	42
-------	-------	-------	-------	-------	-------	-------
$251	$260	$269	$279	$289	$299	$310
$287	$287	$287	$287	$287	$287	$284
230	230	230	230	230	230	227
-------	-------	-------	-------	-------	-------	-------
$57	$57	$57	$57	$57	$57	$57
$57	$57	$57	$57	$57	$57	$57
1.25	1.25	1.25	1.25	1.25	1.25	1.25
$0.1294	$0.1315	$0.1337	$0.1360	$0.1384	$0.1409	$0.1426
$0.1648	$0.1710					$0.2055

IX. MAJOR CONCLUSIONS AND RECOMMENDATIONS

A. Introduction

This Report has attempted to present a concise but complete overview of the current status of development investigations relating to the proposed large-scale geothermal power production and submarine electrical transmission cable facilities between the Islands of Hawaii and Oahu (the "Project"). In addition, the Report has described a scenario for the future development, financing and implementation of the Project which seems to be most appropriate, given the technical challenges and financial magnitude of the Project, the capabilities and interest of the private sector and the overriding public policy and economic concerns of the State Government. This Report has also evaluated the probable financial viability of the Project, based upon currently known design and cost factors and a likely private, project-supported financing plan. Throughout this Report, the emphasis has been placed upon properly addressing the various "real world" risks and trade-offs that will be inherent in devising Project development, ownership and financing approaches that will satisfy the requirements of lenders and investors in the international capital markets. Finally, this Report has attempted to present such information in a practical manner most useful to private industry and financial institutions who may consider participating in the Project.

B. Major Conclusions and Recommendations

1. <u>The Project should be owned and financing arranged utilizing private funding sources and development groups</u>. This approach is most appropriate for several reasons: (a) the $1.5 billion or more cost of the Project is beyond the financial resources available to the State or local governments; (b) there are significant tax benefits under the current Internal Revenue Code that would be available to private owners of the Project's facilities and (c) if various Project-related risks are properly addressed through contract negotiations, the private capital markets have the ability and willingness to provide the debt and equity funds required for construction and operation of the Project.

2. <u>Enactment of legislation to establish a coordinated and streamlined permitting process for the Project was essential to encourage the maximum private sector participation in the Project</u>. Without such legislation, the risks inherent in the existing State and local government permitting processes relating to time delays, multiplicity of permit requirements and resulting costs

would have significantly discouraged the degree of involvement of private parties in the up-front development risk phase of the Project.

3. The State Government should play a major role in the continuing oversight and participate in the coordinated development and decision-making relating to the Project. The magnitude of the Project and its probable impact upon not only the energy supplies of Hawaii, but also its economy and environment necessitate the active involvement of the State Government, on behalf of its citizens. The complexity of such a Project and its various interrelated aspects go beyond the boundaries of the normal concerns of a private commercial transaction and are outside of the narrowly defined issues involved in small-scale cogeneration or independent power sales contracts with electric utilities. In addition, the magnitude of the Project (in relation to HECO's existing generation on Oahu) would be significantly greater than that envisioned for independent cogeneration power projects by PURPA or actually experienced by other states implementing this federal law. This necessary supervisory role for the State Government has been borne out by the practical experiences of other development projects of similar scale and impact, such as the recent Eurotunnel project. The governmental body through which such supervision should be given (i.e. separate authority vs. existing administrative agency or department) and the exact scope of responsibilities of such body should be determined by the State Administration and the Legislature.

4. Based upon current economic and financial information for the Project, it appears to be economically viable, practically financable on a project-supported credit basis and should provide significant savings in energy costs on Oahu during its operating lifetime. This present assessment indicates that additional development, technical, economic and financial investigative work is warranted to verify the final costs and benefits that would result from construction and operation of the Project during the 1990's.

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