SUMMARY OF

HAWAII DEEP WATER CABLE PROGRAM

Prepared for

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The purpose of this document is to summarize the activities included in the Hawaii Deep Water Cable (HDWC) Program with special emphasis on the at-sea test activities. This summary will be used as an informational aid to HDWC Program inquiries and will also satisfy permit application requirements for an environmental assessment.

1.0 BACKGROUND AND GOALS

Crucial to Hawaii's efforts to reduce its dependence on imported fuel for electrical generation and increase utilization of its abundant renewable energy resources, is development of an electrical intertie between the islands of Hawaii and Oahu. (See Figure 1, Project Location Map) The HDWC Program, a research, development and demonstration program, is determining the feasibility and practicality of establishing an interisland, submarine, high voltage direct current (HVDC) cable system.

The HDWC Program is evaluating cables, cable handling equipment, cable vessels, deployment, repair and financing strategies, system economics, potential routes and routing constraints, and environmental impacts. A representative cable has been designed, and segments for laboratory testing will be fabricated. A vessel, capable of deploying and retrieving this cable in the deepest portion of the Alenuihaha Channel, will be procured and outfitted with appropriate cable handling equipment. At-sea tests of deployment and retrieval operations in the Alenuihaha Channel (using a 'surrogate', non-electrical cable or wire rope) will climax the HDWC Program.

1.1 Program Goals

The primary goal of the HDWC Program is "to determine the technical feasibility of deploying and operating a submarine power transmission cable between Kohala on the Island of Hawaii and the Makapuu area of Oahu over a service life of at least 30 years." To accomplish this objective, two areas for which proof feasibility is required are:

- o Accuracy of placement of the cable on the bottom, and
- o Ability to control mechanical loads on the cable.

1.2 Funding

Funding for the HDWC Program is being provided by the State of Hawaii through the Department of Planning and Economic Development (DPED) and the U.S. Department of Energy (DOE). State support began in 1981 (State Fiscal Year 81-82) with the release of funding for work identified as Phases I and I-A. Work performed with these initial funds is described in six technical reports, an Executive Summary and a narrated 35 mm slide program. Spurred on by this show of state support and the successes of Phases I and I-A, a multi-year federally-funded contract was signed in 1982. Continued state funding was assured with the appropriation of funds for state fiscal years 82-83, 83-84 and 84-85. All federally-funded activities are included in the designation Phase II. State-funded activities have been designated as II-A, II-B and II-C to correspond with the 82-83, 83-84 and 84-85 fiscal years.

1.3 Participants

The HDWC Program draws from an international resource pool made up of private sector, government agency, public utility and university personnel. Participants include experts in the areas of oceanography, economics, hardware manufacture, computer modeling, utility system design, cable design, environmental analyses and program management. For both the state- and federally-funded portions of the HDWC Program, Hawaiian Electric Co., (HECO) is the prime contractor with overall responsibility for the program. The Ralph M. Parsons Company, through its Honolulu office (Parsons Hawaii), is the Program Integration Manager with management and technical support responsibilities throughout the program.

1.4 Program Characteristics

Program characteristics are discussed under four potential areas of impact: social, environmental, technical, and economic. Potential social impacts of the HDWC Program are negligible because of the scale and nature of the project. A Public Information Program was initiated early in the HDWC Program. Concerns of government agencies were solicited during special meetings which included a slide presentation and question and answer period. In addition, the Executive Summary for Phase II-A was widely distributed.

Environmental characteristics of the HDWC Program are discussed in Section 2. The at-sea test activities, as well as the test site environment, are also described there.

The technical and economic characteristics of the Program reflect its R&D nature. The Program objective is to determine system feasibility. Technical feasibility infers that all HDWC system and subsystem components can be designed, manufactured or procured, installed, operated, maintained and repaired with a reliability comparable to or exceeding present submarine power transmission system practice. Technical feasibility is being determined primarily in the federally-funded sub-program with major site-specific constraints such as route options and grid system requirements being the focus of state-funded sub-program studies. Economic feasibility infers that the total grid system cost associated with a given baseline commercial cable system configuration results in: (1) a net economic benefit over the expected life of the cable system and (2) a cable system design that is commercially feasible (i.e., it can attract financing). To attract financing, all risks associated with design, construction and operation must be acceptable to the financing community and demonstrated to be properly allocated.

2.0 AT-SEA TEST ACTIVITIES

2.1 Activities

The at-sea testing phase of the HDWC Program will involve the positioning of a 250-foot flat-deck barge in the Alenuihaha Channel to deploy and retrieve a cable (five-inch diameter) in 3000 to 6000 feet of water. The objectives of the at-sea testing are to determine the accuracy of placement of the cable on the ocean bottom, and confirm the ability to control the cable mechanical loads.

A series of test cable deployments will be conducted in the Alenuihaha Channel to ascertain the interactions of the cable vessel, tensioning equipment and cable under various sea conditions. The following typical sequence is envisioned. The vessel will be positioned in the Alenuihaha Channel over the deepest portion of the intended cable route. While proceeding "up-slope" toward the island of Hawaii at a speed of approximately 2 knots, the cable (attached to an anchoring system) will be paid out. A representative length of the test cable will be laid on the bottom without releasing the "bitter end". At the completion of the test deployment, the vessel will be in waters about 3,000 feet deep. The vessel will then reverse direction and retrieve the test cable. No cable will be left in the marine environment following completion of the tests.

Prior to commencement of testing, an at-sea test protocol document and a vessel operations plan will be produced. Together, these documents will completely and precisely describe the test and associated operations.

2.2 Affected Environment

2.2.1 Physical Environment

The project area is in the Alenuihaha Channel between Upolu Point, Island of Hawaii and Kaupo, Maui. The test site is, therefore, oceanic in character with water depths between 3000 and 6000 feet. The project area is approximately one mile by five miles. Bathymetry is shown on Figure 2. The project area may be briefly described as follows: From east to west, the relatively flat bottom of the Kohala shelf (a drowned reef) drops steeply along the Kohala slope to the bottom of the Alenuihaha Channel. The slope is mainly exposed basalt and the Channel bottom is covered with coarse sand.

Currents in the Alenuihaha Channel are characterized by three layers. At the surface is a wind-driven layer, moving generally southwest under the influence of the prevailing tradewinds. Maximum recorded speeds reach almost 3 knots. Below this is a layer characterized by eddy flow. Speeds range between 1 and 2 knots. Below 1500 feet occur reversing tidal currents of generally less than 1 knot. The net drift is toward the northeast, against the wind. The water quality is "good" meaning there are no significant point or non-point sources of pollution in the area. Water quality can be described as in its natural state. The air quality can be described in similar terms. No air pollution problems have been observed in the project area.

2.2.2 <u>Biological</u> <u>Environment</u> The kinds of plants and animals found at or near the site may also be described in terms of layers. In the water column between sea level and approximately 100 meters deep, the flora consists of single-celled phytoplankton. Below the photic zone, there are no floral communities. Animals in the water column (a typical coastal pelagic environment) are fish, squids, shrimp, zooplankton, turtles, whales, etc. Animals in the benthic community are worms, bivalves, gorgonian corals, sponges, mollusks, starfish, urchins, sea cucumbers, etc.

Two species that are found at or near the project area are on the federal and state lists of endangered/threatened species. These two species are the endangered humpback whale (<u>Megaptera novaeangliae</u>) and the threatened green turtle (<u>Chelonia mydas</u>).

2.2.3 <u>Human Use</u>

The project area is an active transportation route for interisland barges and cruise ships. Commercial and recreational fishing also occurs in the Channel. Recreational sailing and boating occurs in the channel but rough conditions often discourage these activities.

2.3 <u>Environmental Impact</u>

Although the HDWC Program is technically complex and will result in establishment of new limits for submarine cable system criteria, its direct environmental impacts will be insignificant - limited to short-term ship operations and temporary disruption of small areas of marine benthic habitats. The DOE, as the federal funding agency, evaluated the potential impacts of the HDWC Program in light of its responsibility under the NEPA, and concluded that there will be no significant environmental impacts and that a NEPA EIS is not required.

There will be a slight alteration of the ocean floor where the test cable is temporarily laid. The ocean floor inhabitants (sessile organisms) that are directly under the cable positioning will be disturbed. The at-sea testing may temporarily preclude some marine activities in the immediate area. Temporary redirection of marine traffic may be necessary, but no more than usual for steering around a large vessel, such as a barge.

Indirect and cumulative effects have greater significance for the HDWC Program. Indirectly, a successful HDWC Program and positive test results will encourage development of a commercial high voltage, direct current cable system. Furthermore, success of a commercial cable program may ultimately alter the source of electrical power for some Hawaii residents and industries.

As for cumulative effects, the project is an independent, self-contained feasibility study. Its successful completion, however, would allow implementation of a full-scale commercial cable system and would encourage geothermal power development on the Island of Hawaii.

2.4 Permitting Requirements

Because of their small-scale, transient and research nature, the operational aspects (at-sea testing) of the HDWC Program will face few permitting requirements. To summarize: (1) It is anticipated that a temporary variance from a Conservation District Use Permit (CDUP) will be appropriate, although this has not been confirmed by the Board of Land and Natural Resources (BLNR); (2) Department of the Army, Corps of Engineers (COE) requirements for a permit to work in navigable waters could be met through either its "Nationwide Permit" system or a "Letter of Permission"; (3) the U.S. Coast Guard (USCG) must be notified at least thirty days prior to initiation of at-sea testing to allow publishing of appropriate information in "Notices to Mariners"; and (4) no county permits will be required. A comparable project, the OTEC cold water pipe at-sea test, required neither a CDUP nor a COE permit.

2.4 Alternatives

To fulfill the basic purpose of the program, two alternatives were assessed. The preferred one is a "reduced-scale" at-sea test. Only mechanical (not electrical) system characteristics will be tested. The second alternative considered is a "full- scale" at-sea test using an electrical grade cable. Both would confirm the technical feasibility of the HDWC Program, but the latter would require significantly higher costs.

Alternative sites for testing (other than the Alenuihaha Channel) were not considered suitable. The basic program goals require site-specific at-sea testing. The simulated deployment operation must be done in the most rigorous conditions expected to be encountered along the proposed route. Previous oceanographic studies have shown the Kohala slope to be the steepest, roughest segment that an interisland submarine electrical cable will have to transit.

If at-sea testing were not possible, it would not be possible to meet the program's goals. A non-at-sea test could conceivably consist of a combined program of physical modelling and computer simulation. These experiments could assess the technical feasibility of deploying an inter-island submarine electrical cable, but not confirm it. The complete system: the environment, the cable, the handling equipment and the vessel would not be sufficiently tested to promote commercial cable development.

A no-action proposal would preclude achievement of the HDWC Program goal. The opportunity for proof-of-concept data and at-sea experience that would be directly transferable to commercial development would be lost.

3.0 CONCLUSION

There are no data that indicate whether present cable design standards and manufacturing practices can be used effectively for a very deep water installation. In terms of value to the technical community, this research program is expected to provide a clear determination of the limits of present state-of-the-art cable design, installation technology and manufacturing practice and extend the present state-of-the-art as required. The HDWC Program will provide the United States with an exportable technology that is in demand by many countries. The proposed interisland cable system itself is fundamental to the state's efforts to attain energy self-sufficiency.

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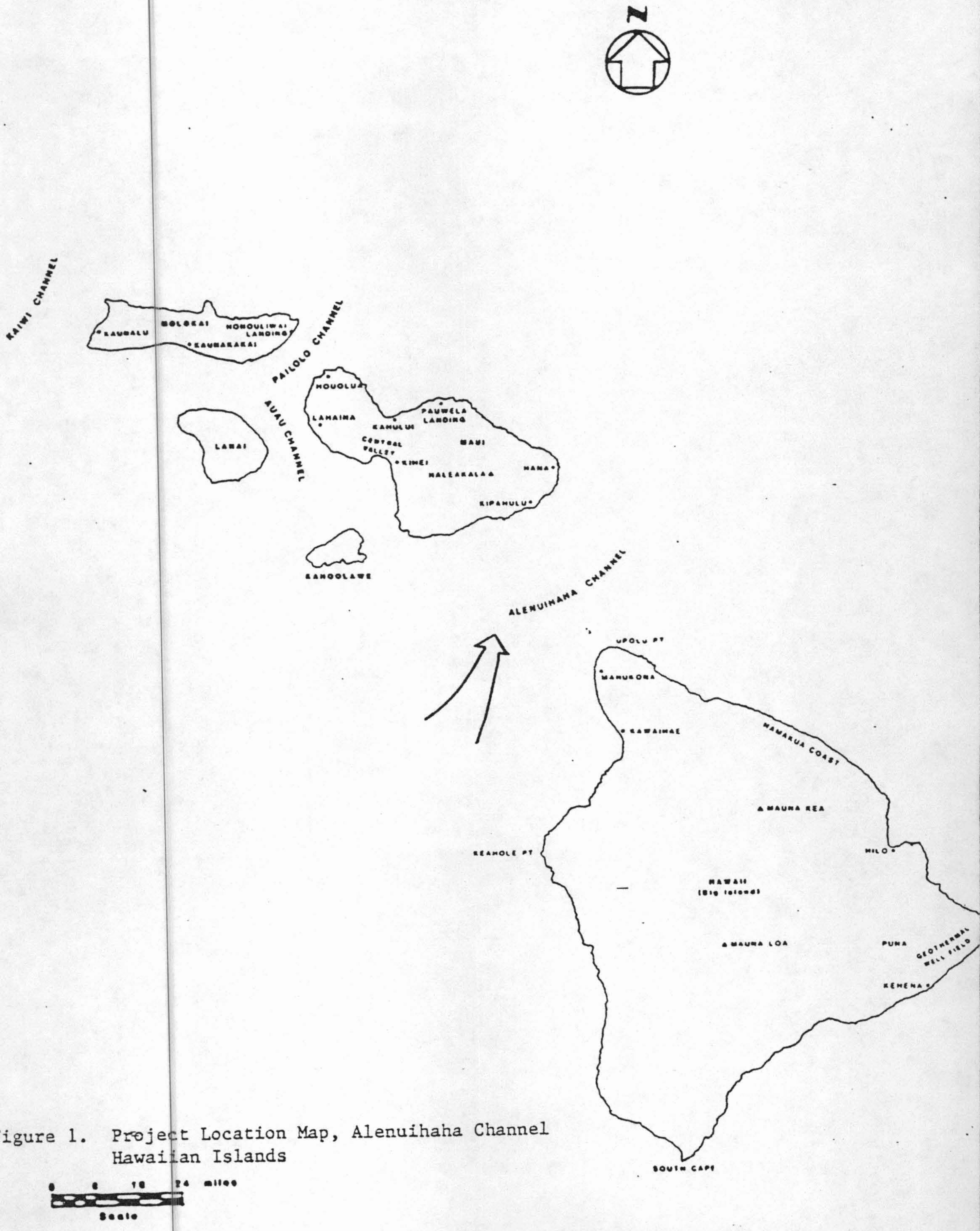

Figure 1. Project Location Map, Alenuihaha Channel
Hawaiian Islands

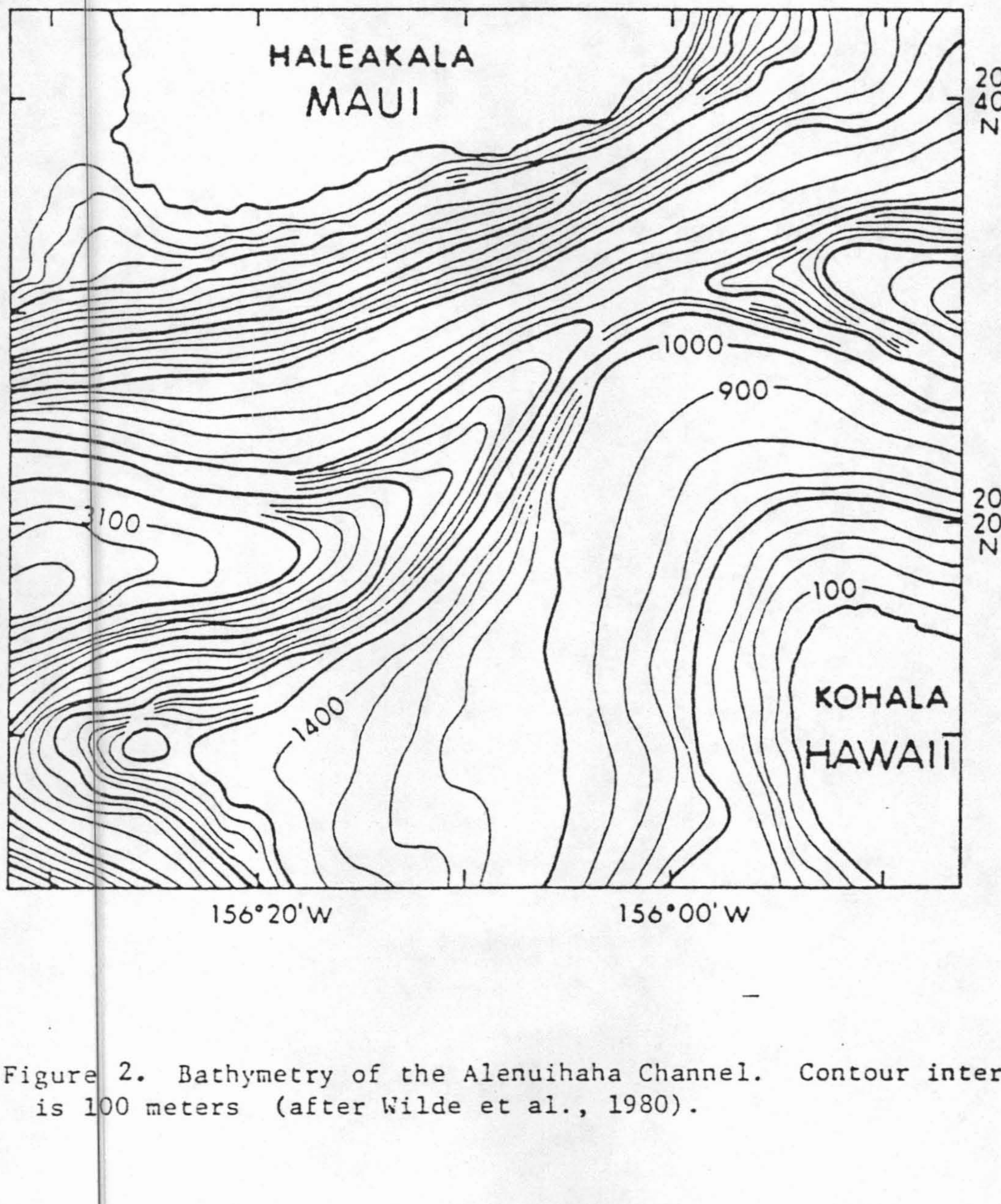

Figure 2. Bathymetry of the Alenuihaha Channel. Contour interval is 100 meters (after Wilde et al., 1980).

Source: Hawaii Deep Water Cable Program, Phase II, At-Sea Route Surveys, U.S. Department of Energy, prepared by J. Frisbee Campbell of the University of Hawaii at Manoa- Hawaii Institute of Geophysics, December, 1983.

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If $200,000 is not provided, a Governor-appointed, temporary (two years), non-salaried, blue ribbon, eight member Board consisting of people such as the Chairman of First Hawaiian Bank, a former governor and a former University president, will not be able to conduct feasibility studies, acquire consultants, travel and perform other functions requiring expenditures. This Board needs to determine an appropriate State Government role, needed legislation and other considerations to finance, develop and operate an interisland electric cable system estimated to have a capital cost of $375 million.

We know of no "external conformance requirements." This is a temporary board of non-paid people who will be hiring consultants in instances when existing resources of the Government cannot provide needed information in a timely manner. It is expected that DPED's Energy Division will provide staff support for the Board.

The Board may or may not need the full $200,000 in FY 1987-88. DPED suggests that the Board's needs for its two-year existence can be satisfied by a single $200,000 appropriation. It is highly likely that most of the funds will be expended in the early part of the Board's existence which will be devoted to information collection and analysis. This portion is relatively more expensive than later deliberation and decision.