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OCEAN THERMAL ENERGY CONVERSION AT KAHE POINT, OAHU: AN ATTEMPT AT COMMUNITY DIALOG

by

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Program on Conflict Resolution

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OCEAN THERMAL ENERGY CONVERSION

AT KAHE POINT, OAHU:

AN ATTEMPT AT COMMUNITY DIALOG

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PREFACE

This case study is one in a series of reports made possible by a joint grant from the State of Hawaii's Department of Planning and Economic Development (DPED) and the Hawaii Natural Energy Institute (HNEI). We are particularly appreciative of the continuing support of Dr.Tak Yoshihara, Director of the Energy Division of DPED, and Dr. Patrick Takahashi, Director of HNEI and professor of civil engineering at the University of Hawaii. The Alternate Energy Development Disputes Series consists of:

Volume 1: Geothermal Energy Development in Hawai'i: A Decade of Conflict. By Sallie F. Edmunds

Volume 2: H-POWER - The Honolulu Program of Waste Energy Recovery - A Case Study on Project Implementation. By Brian Takeda and Sallie F. Edmunds.

Volume 3: Harvesting Biomass for Energy: A Source of Conflict on the Big Island of Hawai'i. By Sallie F. Edmunds.

Volume 4: Ocean Thermal Energy Conversion at Kahe Point, Oahu: An Attempt at Community Dialogue. By Brian Takeda.

Volume 5: A Comparative Analysis of Alternate Energy Development Disputes in Hawaii. (forthcoming)

Portions of these volumes were reviewed by representatives from federal, state and county government agencies, community and neighborhood associations, development companies, environmental organizations, the University of Hawaii, and other individuals. We sincerely appreciate their assistance. The authors alone, however, are responsible for any inaccuracies found in these documents.
Mahalo.

Tom Dinell, Principal Investigator and Editor
for Volumes One through Four
Sallie Edmunds, Research Associate
Brian Takeda, Research Associate

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I. OCEAN THERMAL ENERGY CONVERSION: AN INTRODUCTION

The Ocean Thermal Corporation

The proposed Ocean Thermal Energy Conversion (OTEC) pilot plant at Kahe Point on the island of Oahu is a major undertaking. Commitments of time, money (approximately $320 million), and expertise (no less than 11 subcontractors, see Appendix A: 40 MW OTEC Design Team for details) are required so that at each step the project moves at an orderly and scheduled pace (Hawaiian Electric Co.:1984).

The federal Department of Energy (DOE), which initially proposed the pilot plant, had developed six such steps through which the project would proceed on its way to completion. Federal funding changes have since allowed only two steps to be completed: Phase I, Conceptual Design; and, Phase II, Preliminary Design.

During this early stage of project design and planning, the DOE's prime contractor, Ocean Thermal Corporation (OTC) of New York, chose to conduct a community dialog program. OTC wished to discuss certain OTEC design features that might be viewed unfavorably by the surrounding communities in Waianae (see Appendix B: Major Participants for details).

In the course of the dialog OTC hoped to determine: 1) What the community perceived problems with OTEC might be; and, 2) If the community had suggested solutions which OTC might accept and implement.

The motives behind OTC sponsoring a community dialog can be viewed in at least two ways. First, OTC recognized that while OTEC produced power would prove beneficial to the entire region, enabling Oahu to become more energy independent, the locally borne costs might still not be acceptable to the affected communities. These costs would be in the form of visual obstruction of the sea, potential chemical spills, and possible undesirable effects on the surrounding marine life. By utilizing a "participatory" process, OTC and the affected communities might come to an agreement on what might be done to identify and mitigate potential problems.

Second, by introducing a community dialog at an early stage, design changes or other mitigative measures could still be accommodated at a minimum cost in time, money, and effort. If a dialog were conducted later, when the design was more firmly established, the cost of changes could be significantly greater.

In addition, if OTC had waited until the public hearing stage associated with the complicated permitting process (see Appendix C for a description), not only might design changes prove more costly, but potential litigation could consume both precious time and money. According to Lloyd Jones, Advanced Projects Manager with Hawaiian Dredging and Construction (HDC), a subcontractor to OTC, HDC's experience with geothermal development on the Big Island, H-POWER, and the Barber's Point Deep Draft Harbor on Oahu emphasized the need for early consultation with the community. As Jones put it, "We saw the confrontation and conflict created in those projects. We hoped to avoid or to lessen the situation that led to decisions being made for the wrong reasons for all parties."

In all likelihood, OTC initiated the community dialog motivated by both a desire to address the communities' concerns as well as to minimize project costs. As such, the OTEC Kahe Point case is one in which a developer, prior to seeking any permitting approvals, approached the multiple affected communities with hopes of including them in a participatory process.

The Setting

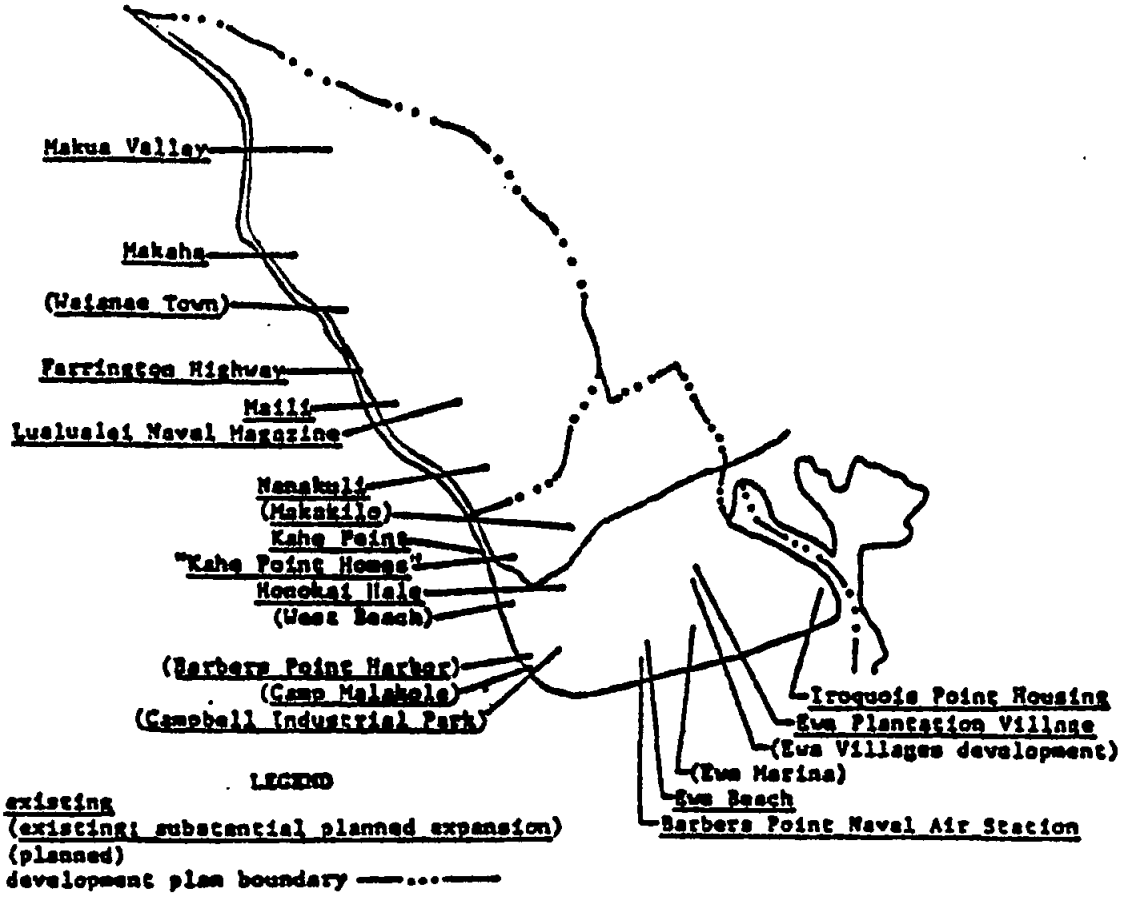
Kahe Point is located on the western shore of Oahu. Geographically, the area is distinguished by a series of ridges extending from the Waianae Mountain Range to the Pacific Ocean. The coastline is divided into a number of pockets and valleys.

OTC identified the potentially affected communities as: Nanakuli, closest to the plant with approximately 8200 residents; Waianae, a community of approximately 7900; Makakilo, a community of about 7700; Honokai Hale, a subdivision of 1200; and, Ewa, a major community of 35,600, but located further away from OTEC than the other communities (OTC:1984). These areas were selected because of their close proximity to the proposed project (see Figure 1).

The Waianae-Ewa area is the site of on-going development. To the south is Campbell Industrial Park, the Barber's Point Deep Draft Harbor, and West Beach Estates, a proposed resort of approximately 9200 hotel/condominium units (Environmental Communications and the U.S. Army Corps of Engineers:1985).

Initially dependent on sugar plantations, the Waianae-Ewa area economic base has since diversified to include light industry,

Figure 1: West Oahu
Map of Existing and Planned
Communities in the Vicinity of Kahe Point



Source: Ocean Thermal Corporation, Predicted Environmental and Socioeconomic Consequences of Constructing and Operating the 40 MW OTEC Plant at Kahe Point, Oahu, 1984, p. 8-7.

diversified agriculture, commercial fishing, and tourism. In comparison to the rest of Oahu, however, economic development has been limited. Unemployment rates have tended to be as much as 40% higher than for Oahu in general, and household incomes have likewise been as much as 24% lower (OTC:1985).

The Ocean

The ocean has traditionally played a significant part in the life of Hawaiians. To early Hawaiians, the ocean represented a major source of livelihood. Food, transportation, recreation, and spiritual values have been derived from it. Religious concepts have emphasized the need to maintain a spiritual unity among the land, the ocean, and man (OTC:1985).

Today, Waianae area residents continue to use the ocean. In light of cultural and economic concerns, residents turn to the ocean for recreational uses such as swimming, surfing, canoeing, fishing, and diving, while some fish for subsistence purposes.

The Case Study

Because the impact of OTEC on these uses was of concern, OTC sought to converse with the communities on how best to proceed. This case study examines that effort (see Appendix D: OTEC Chronology for an overview). Following the introduction, Section II discusses the OTEC principal and the series of events leading to the selection of the Kahe Point site and OTC as the prime contractor. Section III

describes the dialog process and the dynamics among actors. Finally, Section IV presents several observations and conclusions. The appendices serve as references to some of the major points presented in this case.

II. OTEC Technology and the Department of Energy Pilot Plant Program

OTEC is a solar energy technology based on the heat engine principle. Utilizing the temperature differences between the warm surface and colder deep-ocean water, mechanical energy can be derived which in turn can be used to generate electricity. The warm surface water is typically in the range of 75 to 80 degrees F. The deep-ocean water, however, is much colder, approximately 40 degrees F. A cold water pipe over 2000 feet in depth is required to tap this colder water.

Only two OTEC system types have been extensively researched: closed-cycle and open-cycle. Of these two basic types, the closed-cycle has enjoyed far greater engineering development. Many of the engineering concepts have already been proven and demonstrated. The open-cycle at present is not as well developed, and engineering risks are still unacceptable for private investor development.

The closed-cycle system pumps warm surface seawater into an evaporator where a working fluid such as ammonia absorbs heat and is

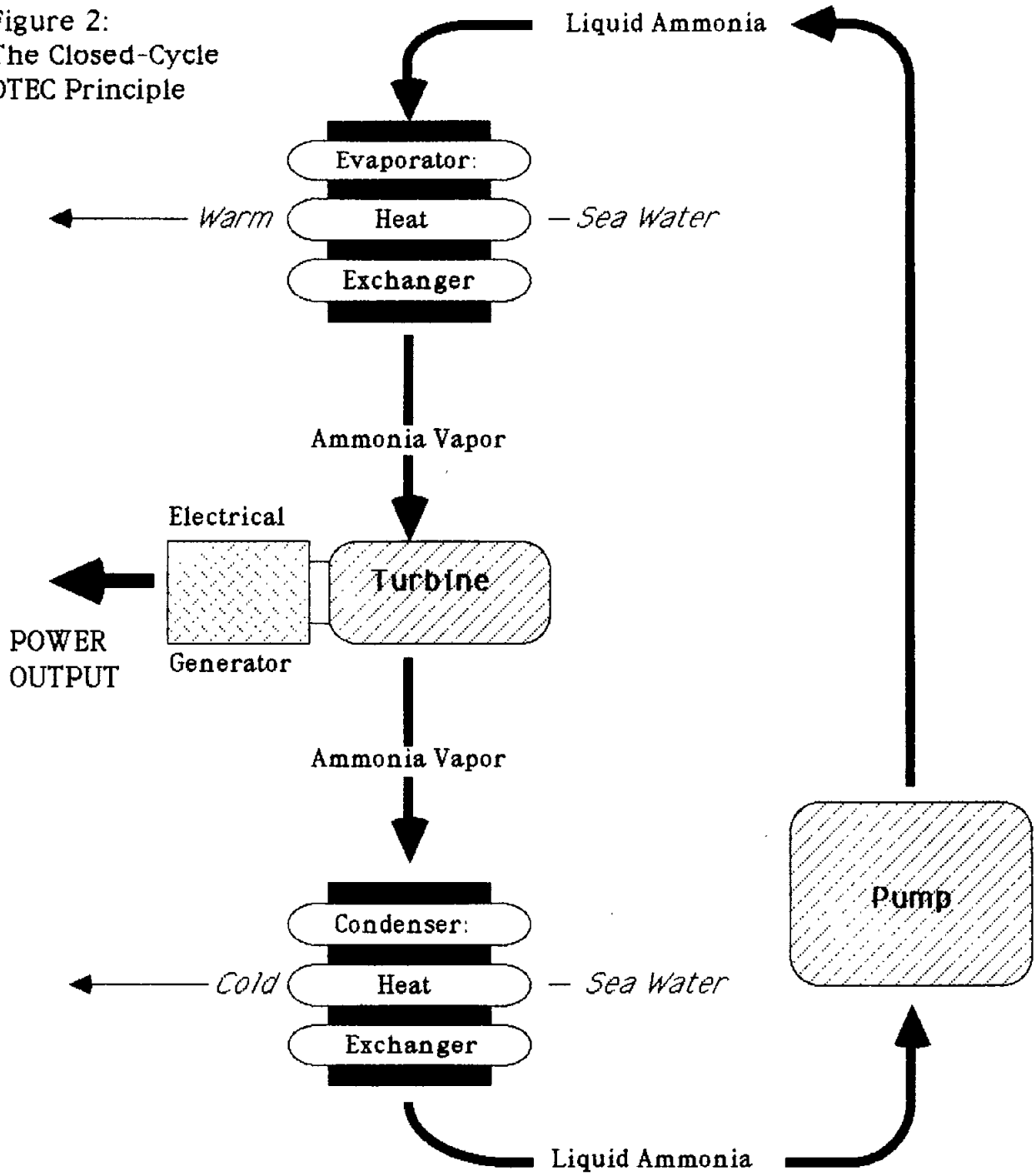
turned into vapor. The vapor drives a turbine connected to a generator, producing electricity. After the vapor travels through the turbine it is condensed back into a liquid by the cold deep-ocean water. As long as the temperature differentials in the ocean can continue to be extracted, the system will continue to operate (see Figure 2).

The advantages of the closed-cycle system are the smaller turbine and vapor passage requirements than needed for the open-cycle. Disadvantages include materials corrosion from seawater and the working fluid, the need for anti-biofouling measures so that the heat exchanger surfaces can continue to efficiently transfer seawater temperature differences to the working fluid, and the high cost of the heat exchangers (Yuen:1981:1).

The open-cycle system has received less research, although current efforts by the U.S. and Japan have intensified (Honolulu Advertiser:7/12/86). The open-cycle is distinguished by the use of seawater as the working fluid. Warm surface water is evaporated in a vacuum in an evaporator or boiler. The low pressure steam is then allowed to expand in a very large diameter turbine generator, producing electricity. After the steam passes through the turbine, cold deep-ocean water condenses the steam and discharges it.

The open-cycle possesses a few advantages not associated with the closed-cycle. Fresh water can be produced, fewer biofouling problems occur since there is no heat exchange between ocean water and a working fluid, and the need for a hazardous working fluid such as ammonia is eliminated. The disadvantages include the need for very large turbines, the need for maintenance of vacuum conditions in

Figure 2:
The Closed-Cycle
OTEC Principle



The closed-cycle system draws energy from the temperature difference between surface and deep-ocean waters. The principle works much like a steam driven electricity generator. Cold fluid is heated and vaporized. The vapor at high pressure moves the blades of a turbine (and then a generator) as it expands toward a cooling system which returns the vapor to its liquid state. In a conventional steam plant, the "working fluid" is water, converted into steam by approximately 1000 degrees F of heat in a boiler. In the proposed Kahe OTEC plant, the working fluid will be ammonia, vaporized by the narrow temperature difference - less than 40 degrees F - between the warm and cold sea water (Paraphrased from Honolulu Advertiser:12/11/80).

large volumes, and flow through power losses which exceed those of the closed-cycle (Yuen:1981:2).

Hawaii's Participation in the Department of Energy Pilot Program

Since 1973, following the Arab OPEC oil embargo, the State of Hawaii has recognized the need to research and develop alternative sources of energy. In 1974 the Hawaii State Legislature established the Hawaii Natural Energy Institute (HNEI) and the Natural Energy Laboratory of Hawaii (NELH) to carry out natural energy research relating not only to OTEC, but other technologies such as geothermal and wind power.

In the years that followed national interest in OTEC grew. In 1977, the Ocean Systems Program of the Department of Energy (DOE) developed a strategy for commercialization of the OTEC principal:

1. Identify ocean energy resources and energy conversion techniques;
2. Assess technological and economic feasibility of OTEC technology;
3. Develop necessary techniques leading to commercialization; and,
4. Share project costs with the private sector to reduce initially high costs and risks.

In the following year, 1978, the State of Hawaii reaffirmed its growing interest in OTEC by mandating ocean energy research and development through the Hawaii State Plan. The DOE at the same time was actively sponsoring OTEC-1, a project designed to test components such as cold water pipes, heat exchangers, and plant mooring systems.

By mid-1979, the State of Hawaii was also active in a joint project with Lockheed Missiles and Space and the Dillingham Corporation (a local Hawaiian firm). On August 2, 1979, the joint project, modestly titled "Mini-OTEC," became the world's first at-sea, closed-cycle, operational OTEC plant to generate usable energy.

In early 1980, given the momentum of the Mini-OTEC success as well as talk of future DOE OTEC funding, the State of Hawaii Ad Hoc Committee for the Advancement of OTEC decided the best site (if OTEC should come to Hawaii) was off the western shore of Oahu at Kahe Point.

Kahe Point, the committee believed, offered two unique features that made it an ideal site. First, the necessary water depth and temperature differences could be found only a short distance from shore; and second, it was immediately adjacent to Hawaiian Electric Company's (HECO) Kahe Point Power Plant. All the necessary facilities to connect OTEC to a major power grid would be conveniently accessible.

Later in the year, two significant federal laws were passed: PL 96-310: The OTEC Research, Development, and Demonstration Act (July 17, 1980); and, PL 96-320: The OTEC Act of 1980 (August 3, 1980).

The OTEC Research, Development, and Demonstration Act mandated OTEC research and development leading to commercialization. To facilitate this, the DOE was directed to establish a pilot plant program. The OTEC Act of 1980, established a one-stop licensing and permitting system for commercial OTEC facilities.

In September, as provided under PL 96-310, the DOE announced a Program Opportunity Notice (PON) for the design, construction, deployment, and operation of a closed-cycle OTEC pilot plant. According to the PON, the DOE would consider a jointly financed

venture with a private developer. Prospective contractors were to submit joint financing proposals and the DOE would select the most qualified and financially advantageous project. The joint DOE/private sector project was to proceed in six phases:

Phase I:	Conceptual design, February 1982 to June 1983;
Phase II:	Preliminary design, September 1983 to November 1984 (last completed phase due to budget cuts);
Phase III:	Detail design;
Phase IV:	Construction, deployment, and acceptance testing;
Phase V:	Joint operational testing; and,
Phase VI:	Transfer of ownership.

A major requirement was that the plant produce a minimum power output of 40 megawatts (MW) so that additional information leading to a full scale plant of about 100-400 MW could be obtained. Nine respondents to the PON were received with three proposed for Hawaii:

1. Ocean Thermal Corporation
2. General Electric/Brown and Root
3. SOLARAMCO

In February, 1982, the DOE decided on two contractors: General Electric and Ocean Thermal Corporation. Both proposed facilities were to to be sited off Kahe Point, Oahu, with the generated electricity to be transferred by cable to the nearby HECO Kahe Point power grid.

The GE proposal was to locate its plant on a fixed steel platform approximately 1.6 km offshore in water approximately 100 m deep. The working fluid was to be Freon.

The OTC proposal was initially to locate a concrete, land based structure on an artificial island approximately 180 m offshore, in

water approximately 9 m deep. A causeway built of rubble was to connect the plant to shore. The working fluid was to be ammonia.

During Phase I: Conceptual Design, OTC determined that plant costs could be lowered by moving the plant to 550 m offshore in 15 m of water. The land-based concept was abandoned in favor of locating the containment structure directly on the sea floor with the rubble causeway to be replaced by a concrete trestle (Office of Technology Assessment:1984).

The GE proposal was also modified. Because of the forces of wave action, structural modifications to the heat exchangers were necessary. This consequently changed the selection of working fluid from freon to ammonia.

By mid-1983 the DOE, having reviewed the results of Phase I by both GE and OTC, decided to fund only the OTC contract for Phase II: Preliminary Design. According to the design studies, OTC's pilot plant would be approximately 113 m long, 72 m wide, and with a roof extending 14 m above mean sea level (OTC:1984:2-2). In other words, the structure would be roughly the size of a football field.

By July 1983, the DOE also decided that additional funding would not continue beyond the results of Phase II. According to a review by the Office of Technology Assessment (OTA), Phase II work was to commence around September 1983, last approximately 18 months, and end in February 1985. Since 1984, however, additional DOE funding has not been forthcoming although the State of Hawaii had already provided almost $2 million for environmental studies.

III. SEEKING TO GAIN COMMUNITY SUPPORT

Entering the Process: The Ocean Thermal Corporation/ Leeward Coast Community Dialog

Under the PON proposal, the DOE was to jointly finance the OTEC pilot project. During this time, however, there was an on-going shift in federal policy toward energy research and development relating to solar energy (OTA:1984:2).

Sometime in late 1982 or early 1983, OTC was notified that the federal share of funding would not continue beyond Phase II: Preliminary Design. If OTC was to complete the project it must do so with funds acquired from private investors. In January, 1983, the State DPED had issued a pamphlet entitled, "State of Hawaii Public Sector, OTEC Program, 1980-1985." The pamphlet stated the DPED had a lead role in assessing impact and public information. OTC, however, decided the DPED would not have to be consulted at that time.

Initial Contact with Waianae Neighborhood Board #24

In late 1983, OTC subcontractors, represented by Lloyd Jones, Advanced Projects Manager for Hawaiian Dredging and Construction (HDC), and John Knox and Berna Cabacungan representing SMS Research (later changed to Community Resources, Inc.), initially contacted the Waianae Neighborhood Board #24 (WNB). The neighborhood boards, which are established by city charter, are composed of representatives

elected from the neighborhood to advise the city council on local issues. The role of Jones, Knox, and Cabacungan was to engage in a community dialog process with the communities in and immediately surrounding Kahe Point at Waianae (see Figure 1). At this time, the OTEC concept and the DOE Program Opportunity Notice (PON) were explained. The neighborhood board was informed that OTC was conducting Phase II planning studies and wished to allow the communities to participate in the process.

The proposal for community participation was to be through the use of an OTEC Community Advisory Committee (CAC). The developer chose to organize a CAC to obtain the involvement of a broader spectrun of community interests than would be available from the neighborhood board alone. The developer would select individuals who were felt to best represent the potentially affected communities and interests.

The purposes of the CAC were to: 1) Identify potential problems which the community believed would result from the OTEC plant; and, 2) suggest potential solutions to OTEC problems which OTC could implement. For example, the OTEC structure would appear as a large concrete rectangle approximately 1/4 mile from shore, 40 feet above sea level, and connected by a concrete and steel trestle. To reduce the visual impact of OTEC, the rectangle housing the power plant might be disguised as an artificial island or the concrete trestle could be designed to accommodate regattas or other boating events (OTC:1984).

The CAC's suggestions for mitigative measures or other solutions were not limited to design changes. Furthermore, according to Knox, any preliminary agreements generated by the CAC would be taken to the Waianae and Ewa Neighborhood Boards for validation to ensure that such agreements were acceptable to the wider community. The procedures to

be followed by the CAC were to be developed jointly by the consultant and the CAC.

The operating time frame for the CAC was to be closely based on the scheduled ending of Phase II federal funding in November 1984. OTC wished to complete most of the preliminary design studies by March 1984. Therefore, the CAC, if it were to have input into Phase II, would have to begin meeting as soon as possible. OTC was also hoping that if the CAC's concerns could be resolved early enough, certain OTEC permits might be processed before the November funding cutoff (WNB #24 Minutes:12/6/83). This could only be accomplished if the design was well established.

To some members of the WNB, the objectives for the CAC were still not clear. OTC would select who would be on the CAC. Even if the selection process were as objective as possible, there would be suspicion as to whose interests the members represented. Despite the OTC concept for community validation, the WNB responded in December 1983 that, "All decisions regarding the issue will be made by the entire neighborhood, and not the members of the CAC" (WNB #24 Minutes:12/6/83).

The OTEC Citizens Advisory Committee (CAC)

In spite of the December comment by the WNB, Jones, Knox, and Cabacungan in January 1984 conducted a public mailing to 13,000 Leeward Coast/Waianae area residents. To facilitate the community dialog each of the mailed packets contained an introduction to the OTEC concept, a description of the proposed plant site, and a diagram

outlining how the OTEC principle would work. Also included was an "OTEC Hotline" phone number which concerned community residents could call to leave taped comments or to request additional information.

At about this time, Knox and Cabacungan of SMS Research were conducting a series of informal discussions with community members from Waianae, Nanakuli, Makakilo, Honokai Hale, and Ewa. According to Knox, a wide representation of interests was desired. For example, Lionel Oki, an attorney who served on the WNB, was invited to serve as a CAC member. Oki eventually accepted. "He would help keep us (the developers) honest," said Knox who was concerned that the community perceive the CAC as representative.

Following the discussion period Knox and Cabacungan selected 12 regular and 6 alternate members for the OTEC CAC. The final criteria used in making the selection included:

1. Adequate representation of the different potentially affected community areas from Ewa to Waianae;
2. Adequate representation of different potentially affected interests such as fisherman, surfers, boaters, businessmen, divers, and canoe paddlers;
3. A history of previous community involvement and leadership; and,
4. A willingness to keep an open mind on the use of a community dialog process to determine how OTC and the CAC can best make decisions about the project.

Through a series of developer presentations at CAC meetings, Jones, Knox, and Cabacungan hoped that at least some items which could benefit the community would be identified. In return for the

communities' acceptance of OTEC, OTC might offer design changes or other negotiated measures. In short, the OTC representatives felt that what gave strength to the CAC was the potential for the community to obtain design changes or other mitigative measures. The consideration of these concessions were to be taken in the form of suggestions (CAC Interim Report:1984).

In retrospect, some CAC members saw OTEC as inevitable. Since the project was coming, the community should try to get whatever it could out of it (Landis:1986). Other CAC members felt that if OTC could not generate some kind of major consensus from all of the potentially affected communities, then there might be a long drawn out battle. During the permitting process, when public hearings were to be held, the community could prolong the process by making claims that the project was not safe, that the impact on the surrounding marine life had not adequately been considered, or any number of related questions (Lapilio:1986). The strength of the CAC for those who took this position was that the potential to defeat the project could be used as leverage in the bargaining process.

Another concern was whether or not the CAC could represent multiple community interests. From January 4 to approximately June 27, 1984, the CAC met regularly once each week for about 2 hours per meeting. At one of the meetings Bob Hoffman, a CAC member commented, "We were not appointed to represent the community. I was asked to represent the scuba diver's concerns. We are not representing the community" (CAC Meeting:2/29/84). At the same meeting another member reiterated Hoffman's concern, "If we say we want fishing on the pier (trestle), it doesn't mean the entire neighborhood wants fishing on

the pier." So, at an early stage (February) at least some of the CAC members felt their role was not to represent the community, but rather specific interests. In retrospect, Knox commented that the CAC was to act as a model of diffusion, taking the content of the CAC meetings back to the wider communities. It was hoped the CAC members would discuss whatever issues developed with their respective interest groups and would in turn ensure representation of those interests at the meetings.

Interestingly, while the developer representatives could identify the role the CAC would play, the members in the CAC had difficulty understanding their role as a group. The members were saying:

1. The strength or power of the CAC could either be in the power to stop the project or, OTC's interpretation, that the CAC could make suggestions which OTC could then carry out; and,

2. The CAC did not represent the Leeward Coast communities but rather specific interests in those communities (fisherman, surfers, etc.).

Another member, who was concerned about potential blasting and safety considerations involved in the use of ammonia and chlorine, saw the issue as much more elementary. If certain questions regarding plant safety could not be answered, then it made no sense to discuss benefits OTC might offer (Ross:1986).

Despite the different interests and views, the CAC meetings continued as planned. By April, the following major issues had emerged:

1. The necessity of a concrete trestle to connect the OTEC facility with the HECO Kahe power station;

2. The effects from construction and blasting and the possibility of ciguatera (fish poisoning);

3. Safety considerations involved in the use of hazardous chemicals, especially ammonia and chlorine;

4. The effects of the cold and warm water pipes on juvenile fish fry and planktonic organisms on which fish fry and other ocean animals feed; and,

5. The development of the Waianae coastline.

The Trestle Option

Early discussions of the use of a connecting trestle centered on:

1. Whether the trestle was necessary to the project; and,

2. If the trestle were built, how it could best be managed so that different ocean users could be accommodated.

To answer these and other questions, various engineers and consultants representing the different subcontractors were brought into the meetings by the developer. When asked if the trestle was absolutely necessary, the response was that there is a very high probability that it would be built. The developer conceded, however, that if the State of Hawaii, through the Board of Land and Natural Resources (BLNR), in its review of the eventual Conservation District Use Application (CDUA) permit, decided that a trestle was unacceptable, then it would be removed. This early statement led many of the CAC and other community members to believe that the trestle was

a negotiable item. This perception was to continue throughout the series of CAC meetings.

If the trestle were built, the question centered on how best to design it to suit the community. Various interests were expressed by scuba divers, fisherman, boaters, and swimmers. A realization soon emerged that it would be difficult to accommodate multiple users simultaneously. Fishermen were concerned about boaters and swimmers making it difficult to fish, while the problem for swimmers and divers would be possible collisions with boats or becoming hooked. This problem, however, while difficult to resolve would later be subsumed by another concern, namely, safety.

Construction, Blasting, and Ciguatera

Because the OTEC facility was to be constructed on an open reef, a certain amount of dredging and blasting might become necessary. Some members of the CAC and the community, having experienced structural damage to their homes during the recent Barber's Point Deep Draft Harbor construction, were openly apprehensive about blasting. Details regarding its necessity and how it was to be done were requested of the developer's representatives. The perception of some CAC members was that the OTC representatives had never determined with certainty whether blasting would be necessary or, if it were, how it would be accomplished. The question of blasting, therefore, was never satisfactorily answered.

Of related concern was the potential for ciguatera poisoning. Ciguatera toxins occur in fish which have been exposed to a specific

form of microscopic algae. When contaminated fish are consumed the central nervous system is affected and the victim experiences symptoms similar to food poisoning. The effects are usually temporary.

Fish contaminated with ciguatera have been associated, but not directly linked, with ocean construction, dredging, and dumping. Residents of Waianae were concerned that if blasting and dredging were required to construct OTEC, then ciguatera was a possibility (OTC:1984).

The occurrence of fish poisoning, however, cannot be answered in a definitive manner. Community members who fish for commercial, recreational, and subsistence reasons were highly concerned. Since the developer could not provide a satisfactory answer, and the construction period was to last approximately two years, these segments of the community began to perceive OTEC as unacceptable.

The Use of Hazardous Chemicals: Ammonia and Chlorine

Ammonia. Even prior to the CAC meetings, concern over the use of ammonia as a working fluid arose (WNB #24 Meeting: 12/6/83). During the CAC meetings the following basic questions were raised:

1. How certain are the developers that ammonia spills or leaks will not occur?;
2. If ammonia does leak what will be the impact on residents living along the coastline?; and,
3. What will be the severity and extent of the impact on the surrounding ocean life?

At one meeting the developer's representatives responded that the plant must be made safe since it will have manned operators. Furthermore, insurance would not be obtainable unless certain safety conditions were met. Although the questions were not directly addressed, Jay Yaffo, President of OTC, who happened to be present at this meeting, alluded to the community interest they were taking into consideration, "Developers don't ordinarily ask for community input, unless they are willing to put back in what they take out" (Recorded CAC Meeting: 2/15/84). Some members of the CAC, however, were not satisfied with this response. "We want to have our questions answered...the engineers are not answering our concerns (regarding the trestle and use of ammonia and chlorine)...we're being ignored, that's what it feels like," said some of the CAC members (Recorded CAC Meeting: 2/15/85).

Between January 4, 1984 and April 3, 1984, the CAC had met with the developer approximately 11 times (WNB #24 Meeting Minutes: January 4, 1984 through April 3, 1984). As far as CAC members were concerned, many questions regarding the use of ammonia remained unanswered.

Although the CAC and community members were not satisfied with the responses, this does not imply the developers did not wish to give them information. The Environmental Assessment was being formulated at roughly the same time the OTEC-CAC meetings were being held. OTC had hoped to release the data as soon as they were published. According to Knox, it was expected that the environmental studies would be completed early enough so that the CAC and the wider community could review the contents. However, because of delays, the data were never received. The OTC representatives, in the meantime,

had not expected to place a great deal of emphasis on technical matters, choosing rather to focus the community dialog on OTEC benefits and potential mitigative measures. As time went on, however, this strategy led the CAC to feel that their questions were not being addressed.

Perhaps realizing this, several engineers and designers who were working on design components were brought in from the mainland by OTC. The answers they gave were still not satisfactory. By August, 1984, the ammonia issue was still unresolved.

One major reason for this problem was that the CAC and the community wanted to receive assurance there would be no leaks or other accidents whatsoever. When one community member realized the project was only in the pilot stage, she exclaimed, "We thought these [OTEC plants] were already built. Are you crazy! We didn't know they were experimental." Another equally emotional plea followed at the same meeting, "...it's our life, our grandchildren. The State may want it, but we have had nothing to do with it...it's never been done. What happens if it doesn't work?" (Information Coordinating Committee Meeting:8/3/84). Thus, another stumbling block threatened to hamper the dialog. On one hand, the community desired firm reassurances that negative impacts would not arise; on the other, the developer's information was much too limited at this early planning stage to satisfy committee members. The need for the community to have their concerns addressed and receive absolute reassurances about safety would continue to be a problem for both parties throughout the CAC meetings.

Chlorine. Like ammonia, chlorine is a hazardous chemical. OTC would require a diluted chlorine solution to kill any algal growth (biofouling) which might hamper heat exchanger efficiency. Similar to the ammonia issue, the community was anxious to be reassured that chlorine use would not be hazardous to the surrounding marine life or to people who used the ocean. Again, because complete reassurances could not be given, the use of chlorine was regarded as unacceptable.

The Cold and Warm Water Pipes

One feature of OTEC is the use of warm surface and cold deep ocean water. The collection pipes used to obtain this water also ingest planktonic organisms, juvenile fish fry, and fish eggs. The amount is difficult to estimate. After passage through the heat exchanger, the organisms would probably be damaged. This issue soon became one of extreme concern. A flyer, published by community members who were not part of the CAC, stated:

> "...Just the warm water intake pipe for OTEC alone will kill nearly 1000 pounds of fish eggs and small fish..., according to a recent OTEC Environmental Assessment. The report says that more than 10,000 adult fish per day or over three and a half million adult fish per year will be sucked into the OTEC pipes and be killed. Millions more fish eggs and keiki (fry) fish will be sucked into the 24-foot diameter cold water intake pipe each year. If built here at Kahe, OTEC would act like a giant ocean vacuum cleaner sucking up fish eggs, fish keiki and adult fish for 24 hours a day, for 30 years" (Talk Story: Na Opio Aloha Aina: 1984).

How the Na Opio Aloha Aina, a group concerned with Waianae's future, came into possession of these data from the Environmental Assessment is unclear. According to Jones and Knox, however, many people in the community went out of their way to tell them that the Na Opio Aloha Aina was representative of an extremist view and not that of the wider community. The Na Opio Aloha Aina, it should be noted, tends to find most forms of commercial denelopment proposed for the rural Leeward Coast objectionable.

In spite of efforts by the developer's representatives to explain that the OTEC structure would serve as a fish aggregating device, it was difficult for them to counter the views presented by the Na Opio, and others. The flyer caused fishers to become concerned about future fish catches and their means of subsistence. The responses given by the developers were not reassuring because of "scientific uncertainties." For many it was probably difficult to view the cold and warm water pipe issue in terms of costs and benefits. Again, if total assurance could not be provided that negative impacts would be avoided, there was no sense in discussing potential OTEC benefits.

Development in Waianae

Throughout the CAC meetings, the developer had expressed a willingness to offer benefits to the surrounding communities. The CAC, however, time and again returned to the issue of safety.

When benefits were discussed, the concern centered on Waianae's high unemployment and associated problems of drugs and crime. Since the developer offered to provide benefits beyond design modifications, some CAC members hoped these concerns could be addressed in some

form through OTEC. The developer suggested at least two possible measures, a jobs program and a grants-in-aid fund.

Preliminary discussions of the jobs program included an apprenticeship for Waianae youth in construction programs. However, early talks in this area were contingent on future discussions with Hawaii's labor unions.

The grants-in-aid funds were to be used by the impacted communities for whatever purposes they decided. The conditions stipulated by OTC included: 1) Expenditure of the funds should be monitored in some way; 2) The communities would be required to have a mechanism to decide how the funds would be spent; and, 3) OTEC would be clearly associated with the grants. Despite the early efforts to search for alternative mitigative measures, little materialized beyond these very general proposals.

Since questions regarding safety and the need for the trestle were not being fully resolved, some community as well as CAC members felt the developer was not being totally open. Adding to the growing mistrust was a proposed House Resolution which not only supported OTEC but stated that the trestle would be a design feature (see Appendix E: HR 193 for details). Members of the Waianae Neighborhood Board, the CAC, and the wider community were made aware of this resolution on May 1, 1984. The CAC/WNB had earlier been informed by OTC that the project had not yet been finalized and that options were still open. The CAC/WNB assumed that this meant the need for the trestle was still negotiable and, more importantly, that "No-OTEC" was a possibility. For the community and CAC members, who were frustrated with the

progress of the meetings, the House Resolution only served to complicate matters. Not all of the CAC, however, saw HR 193 as a conspiracy against the community. Some members felt the resolution was simply an unfortunate example of politicians not in touch with their constituencies. HR 193 was eventually withdrawn, but its introduction helped to surface anti-development sentiments.

The Information Coordinating Committee Meetings

At its June 5, 1984, meeting, the Waianae Neighborhood Board decided to hold a series of four Information Coordinating Committee (ICC) meetings. Their stated function was to "...schedule, facilitate, and conduct a series of public information meetings." Largely as a result of HR 193, the Waianae Neighborhood Board wished to inform more community members of the ongoing Ocean Thermal Corporation (OTC) and CAC meetings. The ICC meetings were to be composed of:

Phase I: Small Sub-District Meetings; and,

Phase II: Public Forum with Dialog.

The series of meetings was to run from July 6 to August 3, 1984, for Phase I, with a single meeting on August 10, 1984 for the final Phase II.

Over the course of the meetings anti-development sentiments, which earlier had been restrained, became more prominent. The issue of ocean mining was raised. Ocean mining was of particular interest since there was a fear that not only would it add to development, but

that it might eventually come to Waianae, resulting in pollution and degradation of the ocean. At the third ICC meeting on July 20, 1984, one community member commented,

> "...Maybe mining at Waianae is not far off. It seems this meeting is for your benefit, not ours. Our concern for jobs in Nanakuli are not being answered. How much profit did Dillingham (HDC) make (from OTEC research money contracted from the State)?" (Recorded ICC Meeting: July 20, 1984).

At the same meeting Jones was also confronted with whether HDC had other mining interests beyond Hawaii. The major thrust and tone of the questioning was one of suspicion, with the continuing feeling that the developer and his representatives were not being totally open. Even though Jones stated that HDC had no present interests in ocean mining in Waianae, many people by now had become anti-OTEC.

Throughout this and previous ICC meetings, the agenda of Jones, Knox, and Cabacungan was to get the community to identify benefits it might desire that OTC could deliver. The CAC and the larger community, however, had two important concerns which had yet to be addressed. The first, regarded the safety of OTEC itself. The second involved apprehension among many Waianae residents about development along the coastline. Any such development would have faced some community opposition, but OTEC was an especially sensitive proposal since it was located in the ocean. Without confronting these issues, the developer could not even begin to initiate a discussion of potential benefits. Two comments sum up the community sentiments at this point:

> "We're not even guaranteed our environment is safe. We don't even have a return on our investment. This is where the anger comes up."

> "Intellectually, OTEC sounds good since it will reduce our energy dependency, but we have our own concerns. We know how dependent we have become on forces outside our community...It is terribly important that you understand that no one asked us about the concern of alternate energy. Most of the people in Waianae would never chose electricity over the Pacific Ocean. The people of Waianae feel used, and dependent politically and economically... we had no part in the origination of OTEC. "What do we get out of it?" is an expression of feelings of being used. As good as OTEC is, it is not part of our decisions. The Waianae people don't buy electricity as a god. On one hand you are committed to it; on the other we have apprehensions of our own..." (Recorded ICC Meeting: July 20, 1984).

The Final Public Meeting

The Phase II ICC meeting on August 10, 1984, involved a community forum. The purpose was to clarify issues which had arisen at the past four information meetings. Only one developer representative, Cabacungan, was in attendance.

The content of the final informational meeting included a series of presentations from various guest speakers. The WNB desired these speakers because of their non-affiliation with OTC, and because they represented an independent expert point of view. Simply put, they were not supportive of OTEC. The speakers included Sherwood Maynard, Director of the Marine Option Program, Sea Grant College Program, University of Hawaii, George Fuller, a biologist with the National Marine Fisheries Service, and Eric Enos of the Waianae Land Use Concerns Committee represented a range of views. The meeting was not emotionally charged as were some of the

previous sessions. When Cabacungan rose to speak, she could only repeat what had been said before, that OTC still wished to continue the dialog and hoped that some solution could still be worked out.

Beside this meeting, two events would further dampen OTC's interests in continuing the discussions. First, only a few days earlier (August 7, 1984) the WNB had come to a decision regarding OTEC:

> "Due to the experimental nature of OTEC with its inherent unknown and unanswerable risk factors, the Waianae Neighborhood Board does not support the proposed plan to build an OTEC plant at Kahe Point, Oahu."

The statement of non-support was certainly damaging to OTC's efforts, but it was the second event which, according to Jones, was the nail in the coffin. The price of oil was beginning to drop from its benchmark price of $34 to $29 per barrel for Light Saudi Crude (Business Week:8/13/84). Furthermore, only a few days earlier a forecast appeared in the Wall Street Journal, predicting oil prices as low as $15 per barrel by 1985 (Wall Street Journal:8/2/84).

The price of oil was important to OTC since it reflected the price HECO would offer for the electricity OTC generated. Under the 1978 Public Utility Regulatory Policies Act (PURPA), utilities such as HECO are obligated to purchase electricity from small scale producers at the same price they would pay for their highest cost alternative (Talbot:1983:41). For HECO the highest cost alternative was oil. Thus, while oil prices remained high OTC could be assured that energy prices per kilowatt hour might make construction of OTEC a financially feasible venture. However, as oil prices dropped the project became

less and less feasible. According to Jones, if oil remained at the $25 to $30 level, OTEC would still have been possible.

The OTEC project, however, has not been totally terminated. It is most likely on hold until an increase in oil prices or a major technological breakthrough once again makes OTEC financially feasible. Since the August 10 meeting little effort to communicate with the community has taken place.

Related OTEC Developments

Rock-Based Ocean Thermal Energy Conversion (ROTEC)

Late in 1984 a Norwegian consortium composed of four engineering and construction firms began investigating the possibility of ROTEC in Hawaii. The concept calls for a below ocean floor OTEC power plant utilizing carbon dioxide as the working fluid. The preliminary studies have indicated the sub-ocean rock strata around areas such as Kahe Point are too porous for ROTEC. Plans for further exploration are pending.

The Pacific International Center for High Technology Research (PICHTR)

Another recent event has been a pledge from the Government of Japan to contribute $1 million per year for eight years towards the establishment of the PICHTR. Recognizing Hawaii as a center for OTEC research (NELH at Ke-ahole Point), the Japanese wish to concentrate on the open-cycle rather than the closed-cycle approach. According to

the Japanese, the open-cycle is viewed as a potential "integrated resource" which can be a source of fresh drinking water, electricity, air conditioning, and aquaculture products (Honolulu Advertiser:5/18/86).

The purpose of PICHTR would be to determine the technological feasibility of the open cycle concept. Much needs to be accomplished before the Center can become operational. The experience at Kahe Point indicates that future OTEC projects will need to include responses to community, environmental, and safety concerns.

IV. REFLECTIONS

The Ocean Thermal Corporation community dialog effort was initially proposed to jointly explore with the affected Leeward Coast communities, possible compensative and mitigative measures which would be granted in return for support of OTEC. In the course of the dialog it was intended that choices for actions would be narrowed and would lead to subsequent implementation. The dialog, however, revealed complex and underlying problems which later served to confound both the developer representatives and the communities.

The Community Perspective

From the communities' perspective OTEC was seen as having significant environmental and aesthetic impacts on "rural" Waianae. Those who fished as part of a subsistence lifestyle were wary of any

threat to their livelihood. Certain residents at Honokai Hale had earlier experienced structural damage to their homes from blasting at the nearby Barber's Point Deep Draft Harbor. Others were simply opposed to any project which might encourage future development and business growth along the relatively undeveloped Leeward Coast. The majority of people enjoyed the ocean and surrounding coastline for recreational uses. Each of these interests represented a range of concerns. Many of these people wanted assurances that the project would be absolutely safe; that it would not pose health and safety hazards if built.

In addition to specific concerns, there were questions about the role of the CAC. While the developer's representatives seemed confident of the purpose of the CAC, the members themselves did not share this same confidence. To many in the community the CAC members had been selected by the developer to decide what their potentially affected communities wished in return for support of OTEC. If the developer had granted this authority to the CAC, could it not just as easily revoke the authority, leaving CAC members with no recourse.

The issue, however, was not quite so simple. According to the developer's representatives the purpose of the CAC was to identify potential mitigative measures which OTC could then offer to the wider community. The mechanisms for developing consensus with the "wider community" were not identified at the initiation of the CAC meetings. It was envisioned that such instruments could be developed as the dialog series progressed. Given the concerns about safety and further stumbling blocks, such as H.R. 193 and the WNB statement of non-support, the dialog never progressed to such a point.

Related to the issue of the CAC's role, was the problem of who the CAC represented. Some members had expressed the concern that they only represented special interests within segments of the community and not the community itself. While the developer's representatives had sought to obtain wide representativeness, the WNB issued its statement that decisions regarding OTEC would be made by the entire neighborhood and not the CAC membership. In part the initial lack of clarity regarding the purpose of the CAC precipitated such a statement.

The Developer's Perspective

From the developer's perspective the information required to address community concerns was not fully available at the early stage of project design when the communities were approached. According to Jones and Knox, information on specific project requirements (e.g., the need for blasting) could only be obtained late in the project design phase. Yet, ironically, the control over the appearance of a project is economically feasible only early in the design stage. This situation caused Knox to later state that this was a "Catch 22" situation: i.e., community input was sought at an early stage when the developer might still be able to implement design changes, but at an early stage definitive data responding to community concerns were not available.

In addition to the "Catch 22" dilemma there were other factors which OTC was experiencing. Members of the CAC felt there was a general lack of coordination between the prime contractor, OTC, and HDC and SMS (Ross:1986, Lapilio:1986, and others). The sense among

the members was that while the representatives were sincere, they were unable to coordinate their efforts. In response, Jones, cited some of the difficulties in coordinating such a project. There are a number of subcontractors, each with a specific design responsibility. When a design change is instituted in one structural aspect, other related changes must be made by other subcontractors. Consequently, subcontractors from different parts of the mainland would have to be contacted. Problems of delays, complexity, and cost are easily created.

One last, but by no means final, factor was the problem of the more vocal individuals who spoke out at the CAC meetings. At times the developer was hard pressed to counter the emotional pleas and assertions that OTEC was about to destroy the livelihood and culture of the numerous residents who relied upon the ocean. In the end there was little the developer representatives could do to counter the impact of these individuals.

The Key Problems

The difficulties experienced by both parties indicate the complexities involved in attempting to incorporate community involvement at an early stage of planning. Present design procedures only allow complete information on the effects of engineering decisions late in the process. This point was amply demonstrated by the blasting issue when engineers explained that based on available information, blasting would probably not be necessary. Only at a later point in the design process, however, could this be confirmed

when a multi-million dollar soils study would be conducted. At the time the affected communities were approached, a complete answer to this question could not be given.

Another key issue was the risk involved in the construction and deployment of OTEC. Many community members never felt they received the complete safety assurances they required. To the developer's representatives, every engineering project involves some degree of risk. The communities perception of risk was heightened because of the use of hazardous chemicals such as ammonia and chlorine.

The difficulties encountered in gaining community consensus contributed to OTC's problems. Because OTC was unable to address a cohesive, unified set of communities, a discussion of ways to find joint agreement on the costs of impacts could not begin. A few in the communities understood the concept of acceptable engineering risks, but to the majority only no risks were acceptable. The communities requested information which might permit more informed judgments. However, the very nature of the project creates problems in assessing risks. As a pilot plant, the information obtained from the actual performance of key components will be used as a basis to develop future large commercial scale plants. But, in order to determine the practicability of specific designs for upgrading to a larger scale, reliability must be proven through actual usage. Thus, the "Catch 22" dilemma creates difficulties for both the developer and the communities.

A final problem is the difficulty the developer encountered in trying to deal collectively with the fragmented interests of a disunified community. The trestle issue revealed that not all CAC

members agreed whether it could be made acceptable. OTC desired the trestle simply because it was the most cost efficient way to construct the facility. However, it was also possible to construct OTEC without a trestle. Earlier engineering plans had not included it. OTC was also aware that if the community were definitely opposed to it, there might be a potential for future delays and court costs. According to Jones, if the community was unanimous in its objection to the trestle, then the no trestle option was preferable to OTC. Yet, the community perception was one of uncertainty as to whether or not the trestle issue should have been pursued and resolved.

As the events finally played out, it was not the problems which arose from conducting the community dialog that put OTEC on hold. Instead, external factors were responsible. The falling price of oil made OTEC no longer economically feasible and federal funding, which could have allowed planning to continue, dried up. Given these events the resolution of differences between OTC and the communities became an academic matter.

Reaching for Agreements

What can we learn from OTC's efforts? What might have been done differently? Basically, there are three major problem areas to address.

Catch 22

The Catch 22 situation resulted in unclear reassurances and commitments being offered by the developer. One possibility for

gaining greater assurances is to have the community involved in establishing criteria to be used as part of the design process. For example, criteria designed to prevent aesthetic disamenities can be used at the outset so that only designs with the least degree of offensiveness will be considered. As the OTC effort demonstrates, community concerns were brought in only after engineering designs for the trestle were fairly well-developed.

To coordinate such an effort will be difficult. A developer must be able to coordinate his/her multiple subcontractors and be able to identify which community concerns to use in developing suitable criteria. Even after these difficulties are overcome, there will still be those who are dissatisfied. The benefit, however, is that the developer can minimize the Catch 22 dilemma. By incorporating community concerns through use of design criteria there may be fewer prospects that a design will be viewed negatively. Questions will still arise however, which can only be answered late in a project's development, but the lack of answers may be more tolerable if acceptable criteria are established in advance.

Risk Factors

There are some risks inherent in any new alternate energy technology. While some risks are more easily addressed than others, there are at least three possibilities for action.

The first possibility is to grant the community the resources to hire its own impartial experts to assess the risks associated with allowing a development such as OTEC. By allowing the community to assess these risks itself, it is likely that distrust over data will

be minimized. The communities' own experts may evaluate and assess engineering and potential impact data and identify areas of disagreement. The thrust of both the developer and communities efforts can thereby more readily move toward dealing with issues.

In the OTC case, this did not occur until late in the dialog when the WNB convened its own series of Informational Coordinating Committee meetings. By that time the potential for resentment at not having questions answered had been allowed to develop. Some "independent" experts were far from objective, and the general ambience was one of anti-development. It is important, therefore, that if a developer makes a grant to a community so that it may retain its own independent experts, it should be done early in the dialog effort.

The second possibility is that the community, through its experts, conduct roundtable discussions on the probability of risks associated with a project such as OTEC. Risks associated with ammonia spillage can be compared, for instance, with the chance of being involved in a serious auto accident while commuting to work. The comparison of risks associated from an unfamiliar technology with that of everyday understandable events can make the concept of acceptable engineering risk more comprehensible to the layperson. Problems such as finding agreements on what constitutes comparable risks may still have to be worked out, but at least two benefits result from the effort. First, the community is exposed to the concept of engineering risk and therefore, may be more open to "acceptable" risks. Second, the possibility of jointly determining costs associated with the taking of risks is opened. Thirdly, the developer and the community

can develop contingency plans as to what will happen if an accident occurs. What will be the nature of the developer's liability? What will constitute legitimate claims for damages? How will claims be processed and by whom? What will the appeal process be? How will the environment be restored and by whom?

Community Representation

Perhaps the most pointed lesson of the OTC dialog attempt is that a developer cannot initiate a successful community dialog unless the mechanism to assess community views is legitimate in the eyes of the community. Designing the mechanism to assess community consensus was to have been a joint developer/CAC effort in the developer's view. Many in the community, however, were suspicious of this mechanism since OTC established the CAC and selected its members. In this regard other possibilities, such as requesting the WNB to perform the CAC function or to appoint CAC members, may have been more strategically useful. In this way problems, such as that reflected in the WNB statement regarding decisions being made by the entire neighborhood and not only the CAC members, might have been avoided. Working through the WNB or a similar body would have given the CAC the degree of legitimacy it never acquired.

Final Comments

The suggestions offered serve as ideas for future directions. Certainly, each of the problem areas identified must be dealt with as part of a comprehensive dialog effort. Yet, establishing the incentive for a community to participate in such a dialog has yet to be fully explored. No dialog can succeed if a community lacks the

incentive to discuss a project with the developer. In this case, despite the unsuccessful offerings made by OTC to Leeward communities, was there a price that could have been offered that would make OTEC acceptable? This unfortunately, is a difficult question to answer. Because of the falling price of oil and the loss of federal funds, potential solutions which might have been negotiated will never be realized. Perhaps in time, as oil prices rise and interest is renewed in OTEC, a developer such as OTC may assess the appropriate mechanism through which successful community participation can be achieved, and its price to the community can be determined.

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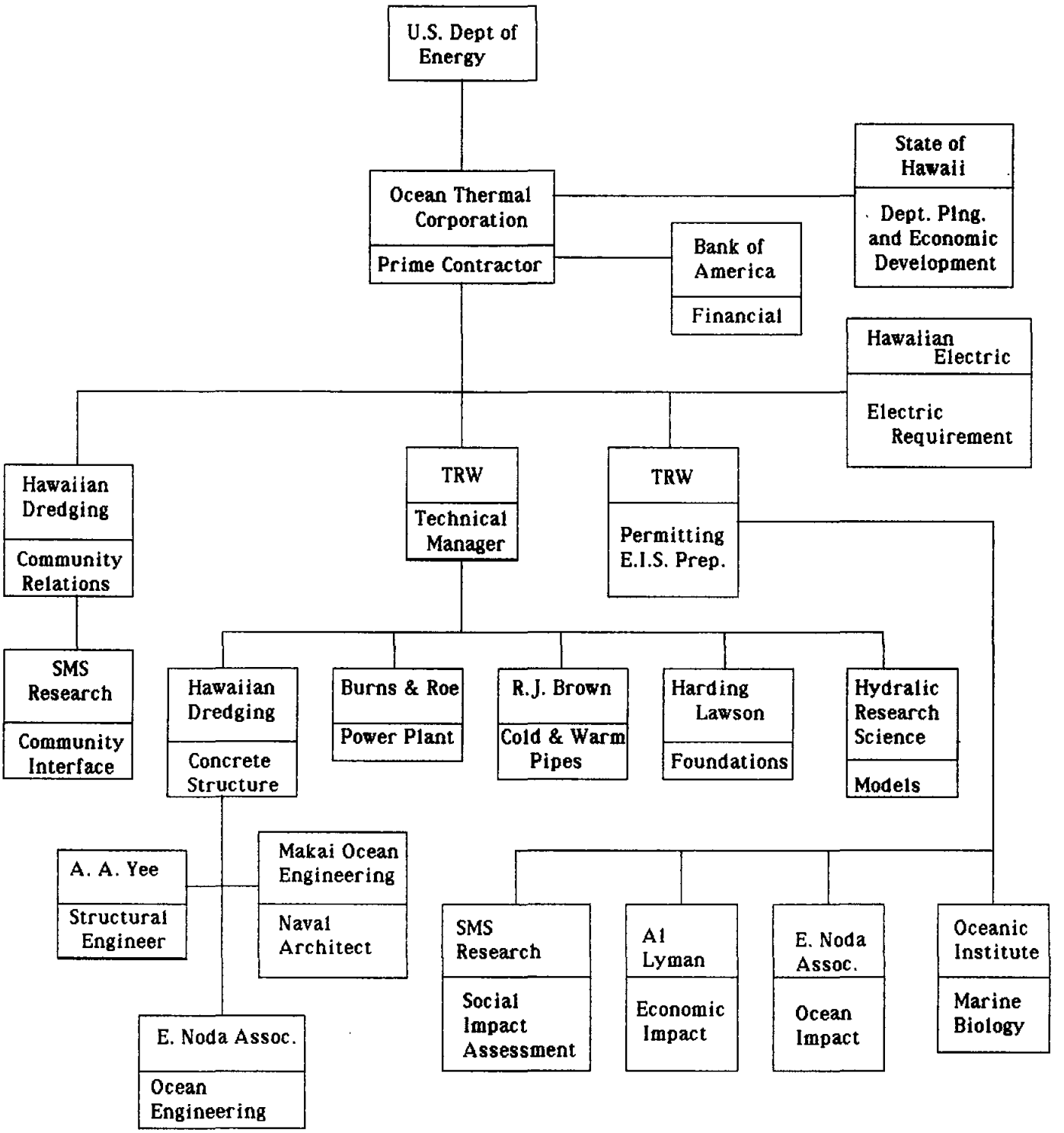
Appendices

Appendix A:
OTEC 40 MW Pilot Plant
Phase II Design Team for
December 1983



Appendix B: Major Participants in OTEC

Principal Developer and Subcontractors

Ocean Thermal Corporation (OTC, major contract awardee) 110 East 59th Street, New York, New York.
Jay Yaffo, President

One of the primary interests of OTC is to fulfill its contractual obligation to the DOE to complete Phase II. Of equal importance is the desire by OTC to proceed beyond Phase II towards the final design, construction and deployment of the OTEC plant. Faced with future federal cutbacks, OTC must secure adequate private funding if the construction is to take place (See Appendix B for an organizational chart relating OTC to its subcontractors).

OTC is also conducting a community dialog process since much of the positive benefits of OTEC will be realized island-wide (that is, throughout Oahu), while its disadvantages will impact local communities along the Waianae coast. OTC is willing to alter its design, to supplement it, or to provide assistance to the community according to the results of the community dialog process.

Hawaiian Dredging and Construction (HDC, subcontractors to OTC) 614 Kapahulu Ave., Honolulu, Hawaii.
Lloyd Jones, Advanced Projects Manager

A subcontractor to OTC, HDC is responsible for assisting in the preliminary design of Phase II as well as facilitating a community dialog process. HDC will enter into future contractual work with OTC should the pilot plant be built.

SMS Research, initial community dialog facilitation contractor, subsequently replaced by Community Resources Inc.

Community Resources, Inc., 735 Bishop Street, Honolulu, Hawaii.
John Knox, President
Berna Cabacungan, Staff

Community Resources, Inc., is also a subcontractor to OTC and serves as the community interface between OTC and the Waianae community. The primary responsibility of Community Resources is to facilitate a community dialog process to determine which concerns of the Waianae community require addressing before the final design of the OTEC plant is established.

Hawaiian Electric Company (HECO, purchaser of OTEC electricity)
820 Ward Ave., Honolulu, Hawaii.
Harold Butler, Alternate Energy Projects Engineer

According to its Phase II, Final Report on OTEC, Hawaiian Electric has stated,

> "HECO is and will continue to be interested in all alternate energy systems insofar as they prove to be economically competitive on our grid. HECO feels that OTEC has the potential to be one of the most reliable and least environmentally objectionable energy systems. Therefore, we wish to see the OTEC concept most thoroughly explored with the hope that it can become an economically viable source of energy as the fossil fuels become increasingly scarce."

Leeward Coast Community Participants

Waianae Neighborhood Board #24
85-555 Farrington Hwy., Honolulu, Hawaii.

The neighborhood board is to serve as a key mechanism through which the Waianae neighborhood may communicate its needs, desires, and concerns to the City and County government relating to basic governmental services, economic development and land use. According to the City and County of Honolulu's Neighborhood Plan, the board may establish community goals, objectives, and priorities (City and County of Honolulu Neighborhood Board Commission: 1985).

OTEC Community Advisory Committee (CAC) and Alternates to the CAC

The CAC members are selected by the developer to represent diverse interests not only in Waianae but also the surrounding communities of Nanakuli, Ewa, Honokai Hale, and Makakilo. The CAC is composed of twelve members with six alternates. The purpose of the CAC is to help the developer determine the problems regarding OTEC which are of most concern to the community and to identify potential solutions. Because several interests, such as local businessmen, surfers, fishermen, anti-development factions and others are included in the CAC, different communities and interests are simultaneously represented. Some members see OTEC as an excellent opportunity to benefit the State as a whole, while others see OTEC as an untested and unsafe experiment waiting to fail.

Other community members, not part of the CAC, are also active participants. Some represent organizations and interests which are not willing to join the CAC even if asked. Others are concerned citizens.

Significant Non-Actors

Federal Government
State of Hawaii
City and County of Honolulu

None of these three major actors participated in the community dialog process.

Appendix C: OTEC Permitting, Licensing, and Other Requirements

The Ocean Thermal Energy Conversion Act of 1980, also referred to as Public Law (PL)96-320, allows for the National Oceanographic and Atmospheric Administration (NOAA) to take mandatory responsibility for all applicants applying for necessary federal level permits and licenses. NOAA will seek all applicable federal authorizations, except for those administered by the United States Coast Guard. According to Section 102(f) of the OTEC Act of 1980, the Coast Guard may apply rules similar to those for all seagoing U.S. vessels. These may include construction of the hull, superstructure, decks, bulkheads, railings, and crew accommodations (Yuen:1981:160). Additionally, the Coast Guard may establish the minimum number of crew members an OTEC plant must have for safe operations (46 U.S.C., secs. 222, 223).

The OTEC Act of 1980 contains four principle features:

1. provides one-stop federal licensing of OTEC facilities and plantships by NOAA;

2. provides that OTEC facilities and plantships be treated as vessels for most purposes under U.S. laws;

3. allows owners of OTEC facilities and plantships to use the capital construction fund tax treatment not available to vessel owners under the Merchant Marine Act, 1936; and,

4. makes both commercial and demonstration OTEC facilities and plantships eligible for Federal loan guarantees under Title XI of the Merchant Marine Act, 1936 (Yuen:1981:157).

The administration of the licensing procedure may involve two processes which may both meet the mandate of PL 96-320. According to the NOAA publication "Permits and Regulations Applicable to U.S. OTEC Projects," the first involves the filing of an OTEC application without the use of a Consolidated Application Review (CAR). The second process involves representatives from each participating federal, state, and local government entity, as well as the licensing applicant. These representatives are designated as a CAR Team and a Joint Agreement identifying the regulatory and review responsibilities of the applicant is drafted. This is followed by interagency meetings with an implementation of an agreed upon schedule for required review, public hearings, preparation of an EIS, and other activities (Yuen:1981:158). The reader is referred to Ocean Thermal Energy Conversion, Permit and Regulation Guide: Hawaii Edition, NOAA, January 1986, for a detailed flowchart explaining the permitting procedures.

State and local notification of permitting processes and procedures are not as well defined, nor as clear as the federal one-stop licensing mandate of PL 96-320. Should OTEC licensing be required, however, the following State and local permits and regulations in all likelihood will be applicable:

1. State

a. Permit for shoreline waters work
b. Conservation District Use Application
c. Designated Groundwater Area Use Permit
d. Environmental Impact Statement
e. Historic Site Review
f. Coastal Zone Management Consistency Review
g. Authority to Construct Permit and Permit to Operate (Air Quality)
h. National Pollution Discharge Elimination System (NPDES) Permit
i. Variance from Pollution Controls
j. Zone of Mixing Approval
k. Permit to Install Utilities within State Highway Rights-of-Way

2. County

a. Special Management Area (SMA) Permit
b. Shoreline Setback Variance
c. Building Permit for Building, Electrical, and Plumbing Work
d. Supplemental Information on Building Permits
e. Variance from Building, Electrical, and Plumbing Codes
f. Conditional Use Permit
g. Grubbing, Grading, and Stockpiling Permit
h. Zoning Waiver
i. Well Permit
j. Certificate of Appropriateness (Historic, Cultural, and Scenic Districts)

3. Other Hawaii Specific Federal Contacts to Consider (listing of other agencies and important sites)

a. Marine Sanctuaries Agencies
b. Properties Listed on National Register of Historic Places
c. Properties Eligible for Listing on National Register of Historic Places
d. Designated Critical Habitat
e. Listed and Proposed Threatened and Endangered Species (Marine)
f. Listed and Proposed Threatened and Endangered Species (Terrestrial)

Appendix D: OTEC Chronological Overview 1974 through 1986

Events Prior to the Developer/Community Dialog

1974

Hawaii State Legislature establishes the Hawaii Natural Energy Institute (HNEI) and the Natural Energy Laboratory of Hawaii (NELH). HNEI is founded as a research center for alternative energy technologies, and NELH is established as a facility for natural energy research.

1975

The Energy Research and Development Agency (ERDA), later restructured as the Department of Energy (DOE), becomes the lead agency for OTEC research and development.

1977

The Ocean Systems Program (OSP), of the DOE, emphasizes the need for commercialization of OTEC. The basic strategy is to:

1. Identify ocean energy resources and energy conversion techniques;
2. Assess technological and economic feasibility of OTEC technology;
3. Develop necessary techniques leading to commercialization; and,
4. Share project costs with private sector firms to reduce initially high costs and risks.

1978

The State of Hawaii, through the Hawaii State Plan, mandates ocean energy research and development.

1978

Mini-OTEC is a Joint project conducted by the State of Hawaii, Lockheed Missiles and Space, and Dillingham Corporation. On August 2, 1979, Mini-OTEC becomes the first at-sea,

closed-cycle, operational OTEC plant to generate usable electricity.

1979

State of Hawaii Ad Hoc Committee for the Advancement of OTEC for Hawaii, is formed in anticipation of future DOE OTEC projects. Committee is headed by the Hawaiian Electric Company (HECO) and the Dillingham Corporation. Supporting committee members include the University of Hawaii, the Office of the Marine Affairs Coordinator, and the State Department of Planning and Economic Development (DPED). By 1980 the committee decides the best site for OTEC is offshore from HECO's Kahe Point power plant on Oahu (DPED:1983).

1980

June 1980: Governor George Ariyoshi, in anticipation of the DOE Program Opportunity Notice (PON), announces that the State will work with any industrial consortium which selects Hawaii for an OTEC test site.

July 5, 1980 to April 1981: DOE sponsors OTEC-1 Project. Global Marine Development, Incorporated, is selected for program management, construction, and operation. Features of the project include:

1. A project run time from October 1980 to April 1981. This is far short of the initial projected three year run time.
2. Objectives are to provide an ocean test facility for OTEC systems, subsystems, equipment, and components to assess heat exchanger technology; long term biofouling and corrosion effects; cleaning and testing techniques; power cycle performance; environmental issues; and ocean engineering baseline data. Due to funding constraints only some of these objectives are met.
3. Three principal outcomes are reached:
   A. Conclusion that OTEC plant ships can be moored in deep water;
   B. A 2200 foot cold water pipe (CWP) can be successfully deployed and attached to plant ship; and,
   C. A 2200 foot cold water pipe (CWP) can successfully weather severe storms at sea.

July 17, 1980: Public Law 96-310, OTEC Research, Development, and Demonstration Act. Mandates OTEC research

and development leading to commercialization, and directs the DOE to establish an OTEC pilot plant program.

August 3, 1980: Public Law 96-320. Ocean Thermal Energy Conversion Act of 1980. Establishes a one-stop licensing and permitting system for commercial OTEC facilities. A major provision is that NOAA will assist the applicant in obtaining all necessary federal level permits leading to deployment. Also provides Title XI loan guarantees under the Merchant Marine Act of 1936. This action facilitates the acquisition of necessary venture capital to finance OTEC. At this time no potential developers have sought Title XI loan guarantees.

September 1980: A Program Opportunity Notice is offered for the design, construction, deployment, operation, and evaluation of a closed cycle OTEC pilot plant funded by the DOE. The pilot project is to be conducted in 6 phases:

Phase I:	Conceptual design, commenced February 1982 to June 1983;
Phase II:	Preliminary design, commenced September 1983 to November 1984 (last completed phase due to budget cuts);
Phase III:	Detail design;
Phase IV:	Construction, deployment, and acceptance testing;
Phase V:	Joint operational testing; and,
Phase VI:	Transfer of ownership.

The requirements of the pilot plant are to include:

1. Minimum power: 40MW net.

2. Objectives:

   A. Encourage development and commercialization of diverse methods, approaches, and applications of OTEC technology;
   B. Design, construct and operate a pilot plant scalable to commercial size by 1990;
   C. For venture capital investors, define commercial products, life cycle cost, risk, cash flow, capital requirements, return on investment, and market penetration;
   D. Establish a user vested interest to ease initial market penetration;

E. Minimize technical risk and the probability of schedule or cost overruns for the pilot plant program;
F. Reasonably project the commercial market penetration in quadrillion barrels of oil equivalent by the year 2000 which can result from the up-scaling of the proposed pilot plant; and,
G. Design the pilot plant for a minimum operating life of seven years.

3. Major information to be gained:

A. Scale-up information: For example, the scaling-up of heat exchangers from small (0.2 - 1 MW) test prototypes to commercial scale (100 - 400MW) is not possible without intermediate exchangers (10 - 40 MW) to certify performance.
B. Market credibility: A pilot plant will help market credibility through demonstrating reliability, survivability, and capacity in an intermediate-sized facility.
C. Practical experience: Information on plant operation, design development, construction methodology and transmission to an existing utility grid system will assist in practical application.

Late 1980: Federal policy interests shift from OTEC to solar energy research and development. Future funding cuts on projects such as the pilot plant are expected (Office of Technology Assessment:1984:2).

1981

Nine respondents to the PON are received with three proposed for Hawaii:
1. Ocean Thermal Corporation
2. General Electric/Brown and Root
3. SOLARAMCO

September to December 1981: State of Hawaii installs deep cold-water pipeline and pumping facilities at NELH laboratory at Ke-ahole Point, on the island of Hawaii. NELH is the only facility in the world which can conduct research with deep cold ocean water.

1982

February 1982: DOE selects two of the nine PON proposals: General Electric and Ocean Thermal Corporation:

1. The GE proposal is to locate its plant on a fixed steel platform approximately 1.6 km offshore in water approximately 100 m deep. The proposed working fluid is Freon;
2. The OTC proposal is initially to locate a concrete, land based structure on an artificial island approximately 180 meters offshore, in water approximately 9 m deep. A causeway built of rubble is to connect the plant to shore. The working fluid is ammonia.

December 1982: DOE invites General Electric and Ocean Thermal Corporation to submit proposals for Phase II: Preliminary Design of the pilot plant.

1983

Mid-1983: Phase I: Conceptual Design results are in:

1. General Electric discovers that expensive structural changes are required to resist the forces of wave action. Questions of long-term reliability also shift the working fluid choice from freon to ammonia;
2. Ocean Thermal Corp. discovers that plant costs can be decreased by moving the plant to 550 meters offshore in 15 meters of water. An artificial island concept is abandoned in favor of siting the plant directly on the ocean floor. A steel and concrete trestle will connect the facility to shore.

May 1983: Based on the results of Phase I work by GE and OTC, an evaluation of project proposals for Phase II, and funding limitations, the DOE decides to fund only OTC. Because of federal cutbacks funding will not continue beyond Phase II.

Approaching the Leeward Coast Communities

November-December 1983: OTC subcontractors Hawaiian Dredging and Construction and SMS Research (SMS Research was subsequently replaced by Community Resources Inc.) approach the Waianae Neighborhood Board #24 expressing OTC's desire to conduct a community dialog process as part of its Phase II: Preliminary Design

planning. They suggest the use of an OTEC Community Advisory Committee (CAC) to:

1. Identify problems the community believes, would result from OTEC; and,
2. Suggest potential solutions to OTEC problems which OTC could implement.

December 6, 1983: Hawaiian Dredging and Construction and SMS Research search for prospective CAC members and the WNB responds that all decisions regarding OTEC will be made by the entire neighborhood and not the members of the CAC.

1984

January 1984: Public mailing of over 13,000 information packets on OTEC to residents in affected areas.

February 1984: Numerous questions are asked at Neighborhood Board and CAC meetings about the use of ammonia, chlorine, and the impact to surrounding ocean life. Throughout the year the CAC and WNB are never fully satisfied with the developers responses to these questions.

May 1, 1984: House Resolution 193 relating to OTEC is introduced. Members of the CAC and the Neighborhood Board regard HR 193 with extreme displeasure. The language describes certain design features as established while the CAC and Neighborhood Board are under the impression the entire OTEC design is negotiable. OTC claims it had nothing to do with HR 193. The resolution is eventually withdrawn.

June 5, 1984: WNB #24 decides to hold a series of four community information meetings on the progress of the OTEC dialog. The meetings run from July 6 to August 3, 1984.

July 10, 1984: World oil prices for Saudi Light Crude begin to decline from $34 per barrel to $29 per barrel (New York Times:7/10/84).

August 7, 1984: WNB #24 issues statement of non-support for OTEC citing "inherent and unanswerable risk factors" as the major reason.

August 10, 1984: Final OTEC informational meeting sponsored by WNB #24.

1985 to Present (1986)

World oil prices continue to decline from approximately $34 per barrel for Saudi Light Crude in 1984 (Wall St. Journal:8/2/84) to $13 per barrel in May 1986. OTC is not pursuing the community dialog program at this time. No meetings have been scheduled since the August 10, 1984 information meeting.

Sometime in late 1984 and continuing into 1985, a Norwegian consortium proposes ROTEC: Rock Based Ocean Thermal Energy Conversion. Firms within the consortium include:

1. AMR Engineering, Offshore Consulting, Norway;
2. Ing. F. Selmer, Civil Engineering and Construction, Norway;
3. Kvaerner Brug, Engineering and Construction, Norway;
4. Institute of Energy Technology, Research Institute, Norway.

The concept calls for a below ocean floor OTEC power plant utilizing carbon dioxide as the working fluid. Preliminary studies indicate the sub-ocean rock around Kahe Point is too porous for ROTEC. Plans for further exploration are pending.

Appendix E: The Waianae Neighborhood Board and House Resolution 193

Source: Waianae N.B. #24 Meeting Minutes: 5/1/84. The basic events are as follows:

1. One of WNB #24 legislative contacts informs the Board of the introduction of HR 193 during the 1984 legislative session. The resolution, in short, supports public fishing in all marine waters surrounding the proposed Kahe Point OTEC facility. It opposes attempts by private interests to deny public fishing, but also endorses development for OTEC and supported additional financing for research and development.

2. The authors of HR 193 include:

   Avis Kiyabu-Saballa, Vice Chair, Committee on Energy, Ecology, and Environmental Protection;
   Joseph M. Souki, Vice Chair, Committee on Ocean and Marine Resources. It is signed by Representatives:

Robert Bunda	Mike Crozier
Clarice Hashimoto	Clayton Hee
Richard Kawakami	Ron Menor
Robert Nakata	Calvin Say
Yoshito Takamine	Marvin Dang
Virginia Isbell	

3. On April 4, 1984, the CAC responds to the authors of HR 193 in a letter. The objections to HR 193 were principally found in its language:

   A. "The State is forging ahead with the OTEC pilot project."

      The CAC/WNB #24 has been told that the project has not yet been finalized and that there are still options open. The CAC/WNB #24 has concluded that this means a "No-OTEC" option as well.

   B. The proposed plant will be connected to HECO's Kahe Point station "via a 1800' long trestle."

      The CAC/WNB #24 has been told by the developer that design options are still negotiable. The iteration of specific design features conflicts with the developer's statements.

C. "There are major unanswered questions over proprietary rights to the marine life that will be attracted to this nutrient rich effluent..."

The CAC is wary of future Ocean Leasing. They wish to retain the public goods right to ocean access, especially if the facility is authorized, and are fearful of having their fishing and recreational uses of the ocean around Kahe Point taken away.

D. "...the local community has valid concerns over the possibility of denied access to resources traditionally considered open to the public."

Language alludes to the possibility of future denied access.

E. "Be it further resolved that this body continue to endorse development of the OTEC Pilot Project at Kahe Point."

Related concern with CAC/WNB #24 that OTEC has not yet been accepted, and that the "no OTEC" option is a valid possibility.

4. The WNB also indicated that, "Furthermore, certified copies of HR 193 were not transmitted to any representative organization, group, or individuals of the impacted community."

5. Other comments provide the following:

A. The CAC has met with OTC representatives for two hours each meeting, each week, dating from Jan. 4, 1984.

B. The CAC has identified:
1. Purpose/Scope of OTEC Plant;
2. Adverse Impacts to Surfing;
3. Adverse Aesthetic Impacts;
4. Adverse Impacts Over Accustomed Use; and,
5. Health Concerns of Construction and Operation.

C. The major unanswered questions include:
1. Whether explosive blasting will be necessary?;
2. If so, what will be the effects to the nearby residential community?;
3. How will it affect the surrounding marine life?;
4. What would be the scope and effect of an ammonia spill to the nearby residential community and surrounding marine life?;

5. What will be done with the OTEC structure after its 30 year life?;
6. Is the 1800' trestle necessary? No studyappears to have been undertaken on alternative designs.

6. In closing, the CAC and the WNB have one final comment,

(Regarding the siting of the facility), there is "no substitute for objective and intelligent scrutiny." (Therefore we hope you) "...avoid jumping on a bandwagon which promises worldwide recognition to Hawaii as pioneers and leaders in ocean energy development."