University of Hawaii at Manoa

Hawaii Natural Energy Institute
Holmes Hall 246 • 2540 Dole Street • Honolulu, Hawaii 96822

FAX TRANSMITTAL

To: _____Manabu Tagomori_____

_____DLNR_____

FAX: _____Runner/Mail_____

From:_____Harry J Olson_____

Date:_____30 September 1993_____

Pages:___-__to follow this cover sheet.

Hi Manabu:

Enclosed are copies of five white papers and plans on geothermal resources development in Hawaii that I said that I would send. There probably is quite a bit of redundancy in the papers, but they should give you a fair idea of some of the work that would be beneficial to geothermal resources development.

I will be glad to discuss these thoughts and other scenarios for geothermal development with you after I return from the GRC annual meeting on October 14th. If you need to contact me before then, Priscilla Thompson, at 522-5620 will be able to get a message to me.

Harry

Harry J Olson

Look Laboratory, 811 Olomehani Street, Honolulu, Hawaii 96813
Phone: 808-522-5620, FAX: 808-522-5618

c/FDLNRMT

hjo08/Sinton

DRAFT

1 February 1990

31 January 1990 Meeting
John Sinton
Don Thomas
Harry Olson

Proposed Locations for Additional SOHs

In Roy Wilkins absence - consult Donnevire and Batista (sp?) for geophysical advise.

PROPOSED LOCATIONS FOR ADDITIONAL SOHs

HAWAII (11)

(3) Kilauea East Rift Zone
1- East of SOH-2
1- North of Lailani Estates between SOH-1 and 4
1- West of SOH-3
Location of holes to be determined by results of initial SOH drilling

(2) Kilauea Southwest Rift Zone
1- North of Great Crack
1- South of Great Crack
Location to West of Volcano National Park to be determined by access availabillity

(1) Mauna Loa Northeast Rift Zone
Location somewhere in the Mountain View - Kulani area at an elevation of approximately 3,000 feet

(2) Mauna Loa Southwest Rift Zone
1- Near South Point on Pali (east) side of rift
1- Kuhuku Ranch area at an elevation of approximately 2,000 feet either above or below the highway

(1) Hualalai Northwest Rift Zone
1- Huehue Ranch above road at an elevation of approximately 2,500-3,000 feet on NW rift zone
2nd priority NW rift below road
3rd priority high of South Rift Zone

(1) Mauna Kea East Rift Zone
Above road
Will provide data for the Deep Continental Drilling program

(1) Kawaihai Prospect
Direct utilization
Should not be as deep as other SOHs

MAUI (3)

(3) Haleakala Southwest Rift Zone
2- Proposed SOH 5 & 6 near Puu Naio
1- near Puu Mahoe (has vols <1,000 ybp) above ranch
Northwest Rift Zone has not been rejuvenated, is not active
Southwest Rift Zone near Hana is too sensitive to site any SOHs

1- West Maui Volcano, rifts have shifted clockwise, the caldera at the top of the mountain is the area of interest, access would be through Iao Valley with road building required past the Needle

MOLOKAI (0)

West Molokai for warm ground water only
East Molokai - most interesting, access problems on NE side
Not recommended for geothermal drilling
"Special Place"

LANAI (1)

(1) Site to east of road in caldera
Never completed evolution illustrated by other Hawaii volcanoes
NW rift curves, SE rift has dikes

KAHOOLAWA (0)

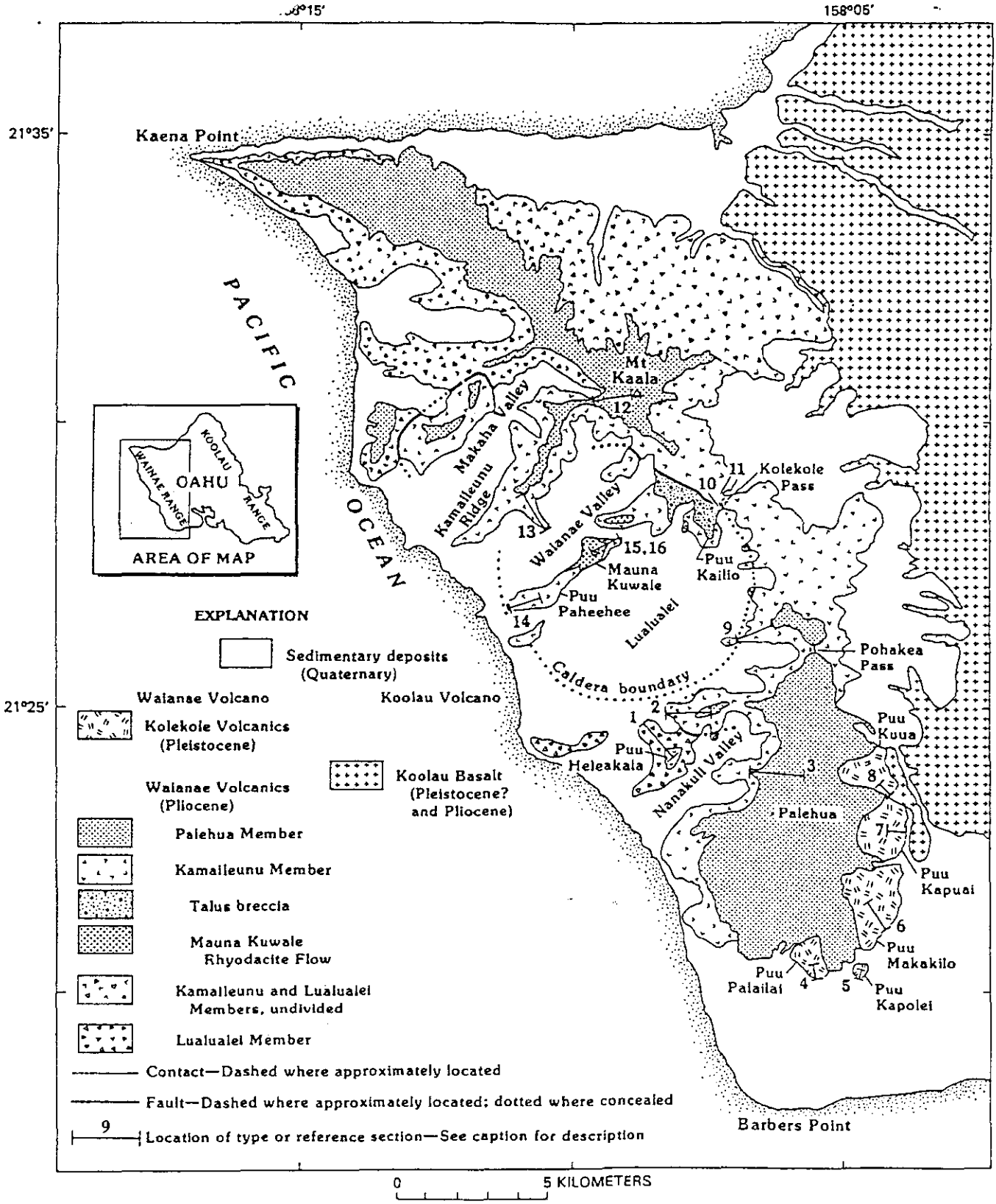
Navy property
Fresh water and Native rights issue

OAHU (1)

(1) Lualualai Valley
site near Kolekole Pass on navy land
Contact Carl Austin (?) at China Lake for coordination with Navy
Kailua, SE Oahu has greatest potential and is site of a migrating caldera
Has most recent activity
Site with most potential is near Castle Junction to east of Olomano

Bruce Tsutsui is the core curator at Snug Harbor (948-6605)

Dick Longfield, HIG/SOEST is director of administrative services, and is the person to contact for use of facility for core curation and storeage


158°15'
158°05'
21°35'
21°25'
Kaena Point
PACIFIC
OCEAN
Mt Kaala
12
Makaha Valley
Kamaileunu Ridge
13
Waianae Valley
11 Kolekole Pass
10
15,16
Mauna Kuwale
Puu Kailio
Puu Paheehee
14
Lualualei
9
Pohakea Pass
Caldera boundary
1
2
Puu Heleakala
Nanakuli Valley
3
Puu Kuua
8
Palehua
7
Puu Kapuai
6
Puu Makakilo
Puu Palailai
4
5
Puu Kapolei
Barbers Point
OAHU
KOOLAU RANGE
WAIANAE RANGE
AREA OF MAP
EXPLANATION
Sedimentary deposits (Quaternary)
Waianae Volcano
Koolau Volcano
Kolekole Volcanics (Pleistocene)
Waianae Volcanics (Pliocene)
Koolau Basalt (Pleistocene? and Pliocene)
Palehua Member
Kamaileunu Member
Talus breccia
Mauna Kuwale Rhyodacite Flow
Kamaileunu and Lualualei Members, undivided
Lualualei Member
Contact—Dashed where approximately located
Fault—Dashed where approximately located; dotted where concealed
9 Location of type or reference section—See caption for description
0
5 KILOMETERS

13 November 1991

A NATIONAL PROGRAM FOR GEOTHERMAL ENERGY RESEARCH AND UTILIZATION

INTRODUCTION

The Hawaii Geothermal Plant - Abbott (HGP-A) was completed in June 1981 as a research, development, and demonstration facility, and after an initial shakedown period began producing base load electricity early in 1982 on a commercial basis. The Noi'i O Puna Research Center (PRC) was dedicated in 1985 as a site for geothermal research and development of all phases of geothermal applications. Funds from the sale of electricity to the Hawaii Electric Light Company Inc. (HELCO) have paid off the loan taken to build the geothermal plant, and in November 1986 the DOE turned over the facility to the State of Hawaii. The geothermal plant and research center have been a great success, and has proven the viability of geothermal energy for direct utilization as well as electrical generation applications. The HGP-A plant has exceeded its design life by four times, and has produced sufficient base load electricity to supply approximately 3,000 people with an on-line reliability of greater than 95%. The Noi'i O Puna Research Center has completed two cycles of community geothermal direct utilization research and demonstration that has been funded by the federal, state, and county governments, as well as from the private sector.

The HGP-A generating facility outlived its useful life and was closed in December 1989. The generating equipment was removed from the plant, and is now operating in Japan. The HGP-A well is currently shut-in, and will not be able to supply hot fluids for research at the PRC until provisions are made to dispose of the waste brine. However, the Puna Geothermal Venture (Ormat), which has completed a 25 Megawatt plant about a quarter mile north of the PRC may purchase brines from the HGP-A well when the plant comes on line in early 1992 and provide a means to dispose of the cooled brine. The True/Mid-Pacific Geothermal Venture drilled a successful geothermal well approximately 10

miles to the west of the HGP-A well along the Kilauea Middle East Rift Zone. If True is successful in developing additional wells, the Venture is permitted to develop 100 Megawatts of geothermal energy on their lease holdings. Also, the Hawaii Natural Energy Institute (HNEI) recently completed three scientific Observation holes (SOH) along the Kilauea East Rift Zone to initiate a program to confirm and assess the geothermal potential of Hawaii. One of the SOHs discovered a potential reservoir in a previously untested area and the other two were successful in defining resource characteristics in the known reservoir and along the Kilauea East Rift Zone.

RESEARCH PRIORITIES

Many of the Pacific Island and Rim Nations and the American Flag Territories that lie along the volcanically active Pacific "Ring of Fire" have a great geothermal potential that could supply their energy needs in a reliable, safe, environmentally acceptable manner, at a cost that is competitive with conventional and alternative energy sources within the framework of their economies. These countries and territories, however, need a research center to test equipment and techniques in an environment similar to their own. The PRC is ideally located to meet these needs, and has the necessary infrastructure to develop into THE Pacific Geothermal Research and Technology Center.

Highlights of the proposed functions and activities of the expanded PRC are:

- Establish the facility as the research and test center of the Pacific.
- Develop an incubator base, or industrial park, from which new industries can be initiated and new technologies perfected. A name suggested for this facility is the "Geothermal Utilization for Energy, Science and Technology (GUEST) Park".
- Create education and training facility ties to the University of Hawaii, the developing geothermal industry on the Big Island, and Pacific Island and Rim countries and territories.
- Promote environmental sensitivity training and research in minimizing environmental impacts.

Specific activities with high priorities are:

- Demonstration of geothermal ground coupled heat pumps for space and process heating and air conditioning.

- Acquisition and testing of high temperature, downhole, logging equipment and instruments.
- Drill an injection well at the HGP-A facility.
- Organize and conduct a mission to the Pacific Island and Rim Countries to advertise and promote the Pacific Geothermal Research and Technology Center.

FUNDING

To accomplish these research goals funding in the amount of $1,000,000 will be require for the initial year of the program with an additional $9,000,000 over the next four years until the facility becomes self supporting. This support will be augmented by funding from state, county, research institutions, foreign countries, and the private sector. Over $2 billion will be needed to develop the geothermal potential of Hawaii. The $10 million requested represents only one-half of one percent of this amount and will provide the seed funding necessary to create the required infrastructure for research, technology development and testing, and the education and training of geothermal scientists and technicians.

c/PRCPLAN

9 January 1992

A Conceptual Plan

for the creation of the

KILAUEA INTERNATIONAL TECHNOLOGY AND APPLICATIONS CENTER

A Collaborative Program of Geothermal Energy Technology Applications, Testing, and Development between Federal, State, County and Local Governments, the University of Hawaii, Industry, and International Organizations and Governments

INTRODUCTION

The Hawaii Geothermal Project-Abbott (HGP-A) facility and the adjacent Puna Research Center (PRC) is currently the only dedicated geothermal research and demonstration facility in the Pacific Basin and is unique throughout the world in that it is associated with a dedicated production well that can provide high and low temperature geothermal fluids for research in electrical generation techniques, direct utilization systems, and other applications. The high silica, heavy metal, and non-condensible gas content of the HGP-A fluids provide a unique opportunity for research and testing in abatement techniques, corrosion and scaling inhibitors, brine handling procedures, and environmental monitoring systems. Hawaii is centrally located within the Pacific "Ring of Fire" in which over 80% of the world's geothermal development has taken place, and is adjacent to geothermal development on the Big Island. The PRC has close affiliations with the University of Hawaii at Manoa and the University of Hawaii - Hilo, as well as, the Natural Energy Lab of Hawaii (NELH) and the Pacific International Center for High Technology Research (PICHTR), and would be ideal as an international training center for geothermal technicians and researchers. The proximity to commercial geothermal developments

could provide opportunities for on the job training and work experience. Geothermal fluids from the HGP-A well, and other possible production wells drilled on the HGP-A site would furnish an energy base not only for geothermal research and development, but also for demonstration facilities and small scale satellite industries. Ultimately, the possibilities for the PRC are limited only by the imagination, an integrated development plan, dedicated management, and the amount of seed funding until the facility can become self-sustaining.

The following provides a background of the geothermal development on the Big Island and the current status of activities as well as an outline of the possible expansion of the PRC into the Kilauea International Technology and Applications Center to take advantage of this great opportunity for the US to continue and consolidate its position as an international leader in geothermal energy technology.

BACKGROUND

The Hawaii Geothermal Plant - Abbott (HGP-A) was completed in June 1981 as a research, development, and demonstration facility, and began producing base load electricity early in 1982 on a commercial basis. The Noi'i O Puna Research Center (PRC) was dedicated in 1985 as a site for geothermal research and development for all phases of geothermal applications. Funds from the sale of electricity to the Hawaii Electric Light Company, Inc. (HELCO) have paid off the loan taken to build the geothermal plant, and in November 1986 the DOE turned over the facility to the State of Hawaii. The geothermal plant and research center have been a great success, and have proven the viability of geothermal energy for direct utilization as well as electrical generation applications. The HGP-A Plant exceeded its design life by four times, and produced sufficient base load electricity to supply approximately 3,000 people with an on-line reliability of greater than 95%. The Noi'i O Puna Research Center has completed two cycles of community geothermal direct utilization research and demonstration projects that were funded by the federal, state, and county governments, as well as from the private sector.

In the private sector, the Puna Geothermal Venture, has completed a 25 Megawatt (net) geothermal plant, which is expected to come on line during the first half of 1992, as soon as sufficient production and injection wells are completed. The True/Mid-Pacific Geothermal Venture drilled a successful geothermal well approximately 10 miles to the west of the HGP-A well along the Kilauea Middle East Rift Zone. If True is successful in developing additional wells, the Venture is permitted to develop 100 Megawatts of geothermal energy on their lease holdings.

In the academic sector, the Hawaii Natural Energy Institute (HNEI) recently completed three Scientific Observation Holes (SOH) along the Kilauea East Rift Zone in a program to confirm and assess the geothermal potential of Hawaii. One of the SOHs discovered a potential reservoir in a previously untested area. The other two SOHs were successful in defining resource characteristics of the HGP-A reservoir and establishing high, subsurface temperature continuity along the Kilauea East Rift Zone.

The HGP-A generating facility outlived its useful design life of approximately two years, and was closed in December 1989. The generating equipment was removed from the plant, and is now operating in Japan. The HGP-A well is currently shut-in, but will be able to supply hot fluids for research at the PRC as soon as provisions are made to dispose of the waste brine. The Puna Geothermal Venture is currently negotiating an option to purchase geothermal fluids from the well when its plant comes on line in early 1992, which will provide a means to disposed of the cooled brine. Alternatively, PGV may provide waste heat from its brines via heat exchangers that could be piped to the PRC for direct utilization and applications research. In any event, the PRC/HGP-A complex is at present not committed and is open to options which will permit maximum utilization of its potential as an international research, development and demonstration facility and training center.

PROPOSED FUNCTIONS AND RESEARCH PRIORITIES

Many of the Pacific Island and Rim Nations and the American Flag Territories that lie along the volcanically active Pacific "Ring of Fire" have a great geothermal potential that could supply their energy needs in a reliable, safe, environmentally acceptable manner, at a cost that is competitive with conventional and alternative energy sources within the framework of their economies. The United States and other developed countries such as Italy, Iceland, Mexico, Japan, Indonesia, and the Philippines that have well developed geothermal industries do not have any facilities to conduct basic and applied research and to test new equipment. The US and these international countries need a research center to test equipment and techniques and train personnel in a facility with an adequate infrastructure and the capability of providing high and low temperature geothermal brines. The PRC is ideally located to meet these needs, and has much of, or the potential, to add the necessary infrastructure to develop into THE international geothermal research and technology center.

Highlights of the suggested functions and activities of the proposed expanded PRC are:

- Establish the Facility as the Geothermal International Research and Test Center.

- Develop an incubator base, or industrial park, from which new industries can be initiated and new technologies perfected. This facility will have adequate office space, classrooms, machine and electronic shops, and training areas. A name suggested for this facility is the "Geothermal Utilization for Energy, Science and Technology (GUEST) Park".

- Create an education and training facility with ties to the University of Hawaii, the developing geothermal industry on the Big Island, and Pacific Island and Rim countries and territories, and other countries with a developed geothermal industry. The facility should develop solid ties with US geothermal companies and US sponsored geothermal laboratories such as Lawrence Berkeley Laboratory, Sandia, the Idaho National Energy Laboratory, and the geothermal developers on the Big Island as a source for "on the job training" and applied research and development. The facility should strive to have a strong international contingent with close ties to international geothermal companies and organizations, and the ongoing UN programs in Iceland and the University of Auckland in New Zealand.

- Promote environmental sensitivity training and research in minimizing environmental impacts.

Specific activities with high priorities are:

- Acquisition of additional adjacent property.

- Drill a core hole for high temperature, slim hole, logging equipment and instruments.

- Drill an injection well at the HGP-A facility.

- Drill a production well as a possible replacement for HGP-A.

- Acquisition and testing of high temperature, slim hole, logging equipment and instruments.

- Establish an environmental monitoring and research facility

- Reinstate and fund the Community Geothermal Technology Program

- Organize and conduct a mission to the UN and Pacific Island and Rim Countries to advertise and promote the Pacific Geothermal Research and Technology Center.

Research capabilities and efforts should include:

- High Temperature/Low Temperature utilization
  - Cascaded Systems Development

- Geothermal Electrical Generation Equipment
  - Improvement of Existing Systems
  - Alternate Generation Systems
    - Hybrid Systems
    - Binary Cycle
    - Sprankle Engine
    - Total Flow Engines
    - Nitinol Engine

- Drilling Technology

- High Temperature, Slim Hole Instruments

- Heat Exchangers

- Brine Utilization

- Materials Testing
  - Thermally Conducting Polymer Cements

- H_2S Abatement Techniques
  - Flow Testing
  - Upstream/Downstream Applications

- Direct Utilization
  - Demonstration of Geothermal Ground Coupled Heat Pumps for Space and Process Heating, and Air Conditioning
  - Process and Materials Heating
  - Aquaculture
  - Agriculture
  - Pumped Storage/Irrigation
  - Spas
  - Other Uses

IMPLEMENTATION PLAN

Geothermal development on the Big Island has become so controversial that it is nearly impossible for regulators and the general public to arrive at informed decisions due to the massive

amounts of emotional rhetoric and misinformation concerning the resource. A step backwards is now required to allow tempers to cool and for the developers to establish a production track record that can be dispassionately evaluated. While this is happening a sound and effective public education, information, and relations campaign must be developed restore community acceptance and support of geothermal resources as a desirable energy source and to regain public confidence in the ability of the industry, and the County and State governments to manage and regulate development of the resource. Perhaps the State, under the auspices of DBED, could lead the way in demonstrating sensitivity to community interests and fears by establishing and supporting a State environmental monitoring and research facility at the PRC.

After the PGV plant comes on line an Energy Planning Group should be formed, perhaps under the auspices of the HGP-EIS program, to evaluate the desirability and conditions for further geothermal development within the State. Members of the group should be composed of moderate, legitimate, and knowledgeable leaders of the diverse interests within the State, and should include, but not necessarily be limited to, representatives of the federal, state, and county governments, local communities, environmental groups, native Hawaiian groups, developers, HEI, and the University. This group would attempt to reach a consensus regarding geothermal and an outline of the ground rules governing development.

The management of the Puna Research Center (PRC) which is currently under the direction of the Natural Energy Institute of Hawaii (NELH) needs to be revised so that direction, management, and funding are not controlled by the marine or OTEC interests at NELH. Management of the facility could be either through the existing NELH structure, or through a separate organization. Future funding of the PRC, and perhaps of the geothermal assessment and characterization program, should be through the University or another non-political research organization.

The State's Scientific Observation Hole (SOH) program, in itself, may have become too emotional and controversial to serve as the vehicle to assess and characterize Hawaii's geothermal resources. Perhaps the program name should be changed to the Geothermal Assessment Program (GAP) to better represent the goals and activities of the program. As soon as the expanded scope of the PRC is defined, its capabilities and mission should be advertised in the Geothermal Resources Council (GRC) Bulletin, the International Geothermal Association (IGA) newsletter, and other geothermal trade journals. Personal contacts should be made within the GRC and IGA at their board meetings, and papers presented at the annual and sectional meetings. Next, a small group should be assembled to meet with UN and AID

representatives, and Energy Ministers or other decision makers of the Pacific Basin and Rim countries, as well as other undeveloped countries and territories. The role of this group would be:

1. to obtain tentative agreements or to establish the ground work for cooperative projects within the structure of the UN and UN sponsored programs, and

2. to acquaint the various countries with the programs and capabilities of the PRC and to urge them to apply through their country governments to the UN or AID for funding necessary to develop their indigenous geothermal resources. The group would also promote US Technology and small scale modular geothermal development programs where applicable.

FUNDING

To accomplish these research goals funding in the amount of $1,000,000 will be required for the initial year of the program with an additional $9,000,000 over the next four years until the facility becomes self supporting. The rate of funding necessary would be $1 million for the first year, $1.5 million for the second year, and $2.5 million for years three through five. This support will be augmented by funding from state, county, research institutions, foreign countries, and the private sector.

Depending upon the size and location of the resource, between $2 billion and $4 billion will be needed to develop the geothermal potential of Hawaii. The $10 million requested represents only one-quarter to one-half of one percent of this amount and will provide the seed funding necessary to complete the required infrastructure for research, technology development and testing, and the education and training of geothermal scientists and technicians.

cSOH/PRCPLANC

5 May 1992

A Conceptual Plan

for a

Program of Community Relations, Environmental Research and Monitoring, and Indigenous Natural Energy Research and Technology Applications at the Puna Research Center

INTRODUCTION

The Hawaii Puna Research Center (PRC) is currently the only research and demonstration facility in the world that can provide a dedicated source of high and low temperature natural fluids for research in high temperature fluid control and treatment, direct utilization systems, and other indigeneous natural energy applications. The high mineral and non-condensible gas content of the fluids provide a unique opportunity for research and testing in emissions abatement techniques, corrosion and scaling inhibitors, two phase fluid handling procedures, materials treatment, direct use applications, and environmental monitoring systems.

Hawaii is centrally located within the developing Pacific Basin and is a world leader in environmental concerns and indigenous natural energy research and development. Hawaii has a well developed infrastructure; an educated population; a high technological, educational, and industrial base -- including the University of Hawaii at Manoa and the University of Hawaii at Hilo, the Pacific International Center for High Technology and Research (PICHTR), and the Natural Energy Laboratory of Hawaii Authority (NELHA), which, in additional to marine research, conducts Ocean Thermal Energy Conversion atudies at its Keahole facility, and other non marine natural energy research at the Puna Research Center (PRC).

The PRC is small, but well equiped to conduct natural energy research. The facility currently is the site of an active indigenous geothermal assessment program, and would be ideal as an international training center for environmental training and monitoring and natural energy research applications. However, at present the PRC is underfunded and needs seed funding to develop programs to better utilize its potential as THE natural energy center for the Pacific Basin and surrounding rim countries.

Never-the-less, through a series of unfortunate mishaps and management and regulatory oversights over the past several years, geothermal development on the Big Island has become so controversial that it is nearly impossible for regulators and the general public to arrive at informed decisions due to massive amounts of emotional rhetoric and misinformation concerning the resource and its impacts. A step backwards is now required to allow tempers to cool, and for the developers to establish a production track record that can be dispassionately evaluated. While this is happening a sound and effective public education, information, and relations campaign must be developed to restore community acceptance and support of geothermal resources as a desirable energy source, and to regain public confidence in the ability of the industry, and the County and State governments to manage and regulate development of the resource. Perhaps the State of Hawaii, in partnership with the Federal Government, could select a professional mitigation team, in an attempt to form a working relationship between the community, the State, and the developers, based upon cooperation and mutual trust. A key ingredient to the development of a viable energy program for Hawaii, could be the expansion of the PRC functions to include the:

- establishment of an education, training, and demonstration facility with strong ties to community, and local academic institutions. Over time these ties could expand to include international industrial, governmental, academic, and research institutions. Strong working relationships should be maintained with organization such as the UN, AID, and the World Bank.

- establishment of an environmental training, research, and monitoring program to minimize the impacts of indigenous energy development on the environment and the surrounding communities. This program would also fund the development of technology to measure and monitor ambient conditions, such as air and groundwater quality, that are affected by natural processes and human activities.

- development of a demonstration and technology applications program, initially with active support for local businesses and entreprenures and demonstration or technology projects with immediate application to natural energy development. This program should develop into an incubator base or industrial park, from which new industries can be initiated and new technologies perfected.

Several ongoing and new projects could be supported under the revised PRC programs, and could include the reactivation of the Community Geothermal Technology Program for direct

utilization applications at the Puna Research Center, the development of a working prototype laser activated, fiber optic temperature probe capable of measuring temperature and other parameters such as groundwater pressure, pH, and specific ion concentrations, and the development of a portable ultraviolet Light Detection and Ranging (LIDAR) model capable of measuring and monitoring atmospheric gas composition and particle size from industrial and natural emissions.

FUNDING

Te accomplish these research and programatic goals, funding in the amount and should strive to have a strong working relationship with the UN, AID, and the World Bank. The facility could develop as an incubator base, or industrial park, from which new industries can be initiated and new technologies perfected.

- to provide environmental training, research, and monitoring to minimize the impacts natural processes, and population and business growth.

- to develop an educational and training program with the capability to conduct natural high temperature technology research, testing, and application.

Specific activities with high priorities are:

- Acquisition of additional adjacent property.

- Acquisition and testing of high temperature, slim hole, logging equipment and instruments.

- Establish an environmental monitoring and research facility

- Organize and conduct a mission to the UN and Pacific Island and Rim Countries to advertise and promote the Kilauea International Technology and Applications Center.

IMPLEMENTATION PLAN

As soon as seed funding is obtained and the scope of the Kilauea International Technology and Applications Center is defined, its capabilities and mission should be widely disseminated throughout the US and international communities via academic and technical societies publications and newsletters. Personal contacts should be made at meetings, seminars, and workshops; and papers presented at the annual and sectional conferences.

Next, a technical group should be organized to meet with UN and AID representatives, and Energy Ministers or other decision makers of the Pacific Basin and Rim countries, as well as American Flag territories and other undeveloped countries. The role of this group would be:

- o to obtain tentative agreements or to establish the ground work for cooperative projects within the structure of AID and UN sponsored programs, and

- o to acquaint the various countries with the programs and capabilities of the Kilauea International Technology and Applications Center, and to urge them to apply through their country governments to the UN or AID for funding necessary to develop their indigenous natural energy resources in an economically sound and environmentally responsible manner. The group would also promote US technology and services, and small scale modular natural energy development programs where applicable.

Finally, another group would be organized to plan and organize the development of the Kilauea International Technology and Applications Center facility, and to provide supervision for the initial research projects which would be administered by the Center.

Two research projects are proposed for the first year that would be managed by researchers from the University of Hawaii at Manoa. The first will develop a prototype, portable, long-length (3 Km), fiber-optic, remote Raman temperature probe and sensor for field use in high temperature and hostile environments. The probe will have application in measuring and monitoring industrial processes, geologic phenomena, and the high temperature wells routinely encountered in petroleum and geothermal drilling, and will represent a doubling of the current capability of real time temperature probes which are not reliable and fail above approximately 225-250^{o}C. The probe has the potential also to measure other parameters such as pressure, pH, and dissolved mineral species and specific ions.

The other research project will develop a portable, solar-blind, pulsed-UV, LIDAR (Light Detection and Ranging) capable of determining and monitoring volcanic gas composition, temperature, and particle size distribution measuring both elastic (Raleigh and Mie) and inelastic (Raman) scattering from atmospheric gasses, volcanic smog, lava haze, and other natural or industrial emissions. The proposed LIDAR instrument will have direct application in measuring atmospheric pollution currently caused by the continuing eruption of Puu Oo on the big island of Hawaii and in providing air quality data Federally managed Hawaii Geothermal Program EIS.

FUNDING

To accomplish these research goals funding in the amount of $1,000,000 will be required for the initial year of the program with an additional $9,000,000 over the next four years until the facility becomes self supporting. The rate of funding necessary would be $1 million for the first year, $1.5 million for the second year, and $2.5 million for years three through five. This support will be augmented by funding from state, county, research institutions, foreign countries, and the private sector.

A tentative budget for the first year's activities by the Puna Research Center's Indigenous Natural Energy Program is a follows:

Proposed Activity		Cost
Education & Training		$ 350,000
o Community Awareness	100,000	
o Community Energy Technology	150,000	
o Indigenous Energy Display	100,000	
Technology Applications		275,000
o Hi Temp Fiber Optic Probe	75,000	
o Energy Applications	150,000	
o Pacific Island Nation	50,000	
Environmental Research & Monitoring		375,000
o UV LIDAR R and D	175,000	
Monitoring Data Analysis	200,000	
TOTAL		$1,000,000

c/KITAC2

26 February 1993

PROPOSAL FOR A GEOTHERMAL ENERGY RESEARCH AND COMMERCIALIZATION CENTER

INTRODUCTION

The Hawaii Puna Research Center (PRC) is currently the only research and demonstration facility in the world that can provide a dedicated source of high and low temperature natural fluids for research in high temperature fluid control and treatment, direct utilization systems, and other indigenous natural energy applications such as solar, wind, biomass, methanol, and hydrogen. The high mineral and non-condensible gas content of the fluids provide a unique opportunity for research and testing in emissions abatement techniques, corrosion and scaling inhibitors, two phase fluid handling procedures, materials treatment, direct use applications, and environmental monitoring systems.

Hawaii is centrally located within the developing Pacific Basin and is a world leader in environmental concerns and indigenous natural energy research and development. Hawaii has a well developed infrastructure; an educated population; a high technological, educational, and industrial base -- including the University of Hawaii at Manoa and the University of Hawaii at Hilo, the Pacific International Center for High Technology and Research (PICHTR), and the Natural Energy Laboratory of Hawaii Authority (NELHA), which, in additional to marine research, conducts Ocean Thermal Energy Conversion studies at its Keahole facility, and other non marine natural energy research at the Puna Research Center (PRC).

The PRC is small, but well equipped to conduct natural energy research. The facility currently is the site of an active indigenous geothermal assessment program, and will be ideal as an international training center for environmental training and monitoring and natural energy research applications. However, the PRC currently is underfunded and needs seed funding to develop programs to better utilize its potential as THE natural energy center for the United States, the Pacific Basin, and surrounding rim countries.

A key ingredient to the development of a viable energy research and commercialization program at the PRC would be the expansion of its current functions to include the:

- o establishment of an education, training, and demonstration facility with strong ties to community, and local academic institutions. Over time these ties will expand to include international industrial, governmental, academic, and research institutions.

- o establishment of an environmental training, research, and monitoring program to minimize the impacts of indigenous energy development on the environment and the surrounding communities. This program will also fund the development of technology to measure and monitor ambient conditions, such as air and groundwater quality, that are affected by natural processes and human activities.

- o development of a demonstration and technology applications program, initially with active support for local businesses and entrepreneurs and demonstration or technology projects with immediate application to natural energy development. This program will form the incubator base or industrial park, from which new industries can be initiated and new technologies perfected and commercialized.

Several ongoing and new projects will be supported under the PRC programs, and will include the upgrading of the current facilities so that the facility can become self contained and supporting, the reactivation of the Community Geothermal Technology Program for direct utilization applications, the development of a working prototype laser activated, fiber optic temperature probe capable of measuring temperature and other parameters such as groundwater pressure, pH, and specific ion concentrations, and the development of a portable ultraviolet Light Detection and Ranging (LIDAR) model capable of measuring and monitoring atmospheric gas composition and particle size from industrial and natural emissions.

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