

# Natural Energy Laboratory of Hawaii Authority

**1995 Annual Report**



N E L H A

## **NELHA's Mission**

**"To develop and diversify the Hawaii economy by providing resources and facilities for energy and ocean related research, education and commercial activities in an environmentally sound and culturally sensitive manner."**



## *MESSAGE FROM THE CHAIRMAN*

The Natural Energy Laboratory of Hawaii Authority has served as the location for some of the most exciting research, commercial, and educational programs and activities in the nation. The past year was difficult and critical to NELHA as the lab streamlined its operations due to the state budget crisis. Despite the cuts, NELHA remains focused on



serving its current tenants and attracting new ones. Our mission to develop and diversify the Hawaii economy remains foremost in our minds as we forge ahead with a new organization and stronger focus.

Over the past two decades, NELHA has received worldwide recognition for its pioneering efforts in the development of cold deep seawater technologies. The applications developed at Keahole Point inspire many countries who have access to cold seawater. This year, government officials from Okinawa and The Philippines requested the advice and expertise of NELHA in the development of similar projects in their countries.

NELHA added four new tenants during this past year. Other tenants expanded their operations, grossing over \$5 million in sales, providing employment to more than 100 individuals, and completing capital improvements on over 20 acres. In addition, several NELHA tenants received significant grant funding in support of their research, commercial, or educational activities. We strive to create an environment that is supportive of business, fostering development and success. As a result, NELHA has become more financially self-sustaining and less reliant on general funds from the state. NELHA is continually evaluating the results of our efforts in business development, services to tenants, and infrastructure. We are examining new ideas to improve our operation, and formulating long range plans for the future development of the facility. Stronger collaboration between other public and private agencies is part of our focus to improve our services and further our mission. We look forward to another year of tenant growth and business success at the most innovative and unique ocean research and technology park in the world.

I would like to thank all of our staff, tenants and friends for their support.

A handwritten signature in dark ink, appearing to read "Rick West". The signature is stylized with a large, looping "R" and a cursive "West".

Rick West  
Chairman of the Board

## *MESSAGE FROM THE EXECUTIVE DIRECTOR*

1995 was one of the most challenging years for the Natural Energy Laboratory of Hawaii Authority (NELHA). The challenge was to "rightsize" NELHA in both staff size and budget. The result is a streamlined and efficient staff who will be focused more intently on functions that support the mission of NELHA.



While our staff got smaller, the number of tenants is getting larger. Four new tenants were received this year, while four others are discussing plans to locate to NELHA next year. As part of our expansion program into the 548 acre undeveloped lands of NELHA, our recent infrastructure planning has set aside about 230 acres of land for three large businesses which currently intend to expand or locate into these lands. Several other projects are also interested in locating into this area when the utilities, seawater distribution system, and roadways are completed.

The first phase of the seawater expansion system into the 548 acre undeveloped lands is not expected to be completed until the Spring of 1996. The delay has been due to some unexpected engineering challenges in the tunneling process, called microtunneling. As I indicated in my message in the 1995 Annual Report, this phase will install two 55 inch diameter seawater pipes under the coastline beginning from a point 460 feet onshore at a depth of 32 feet to a point 540 feet offshore at a depth of 80 feet. The next phase will install a seawater pipeline from the seaward end of the 55 inch pipes to a depth of 3000 feet and build a pump station at the onshore end of the pipes. This seawater system still remains the most critical requirement for our expansion into the 548 acre undeveloped area.

While 1995 has been a year of challenges, 1996 and the years ahead are viewed as years of opportunity: opportunity to develop and diversify the economy of Hawaii and opportunity to assist businesses in establishing themselves and to help them grow. The staff and I look forward to these opportunities to build NELHA into the world's finest center of excellence for ocean and energy related technologies.

A handwritten signature in black ink, appearing to read "Robert Kihune". The signature is stylized with a long, sweeping horizontal stroke at the end.

Robert Kihune  
Executive Director



# 1995 The Year in Review

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## BOARD OF DIRECTORS

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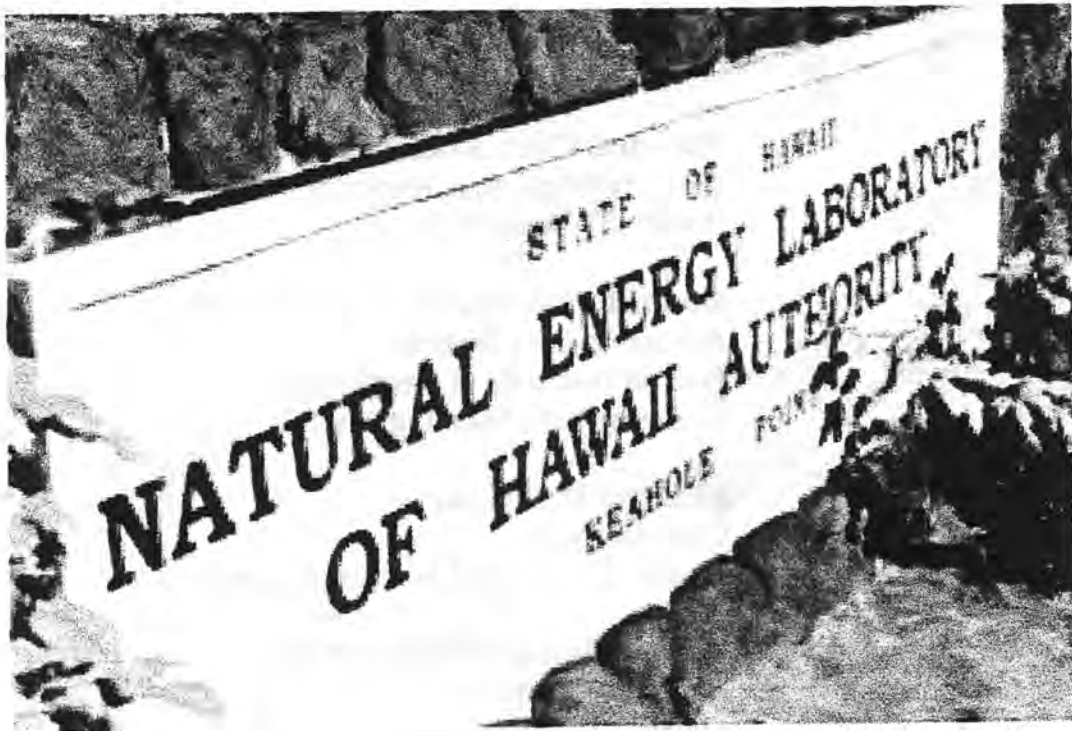
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***Stephen Yamashiro***

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County of Hawaii

## 1995 NELHA TODAY



NELHA has a vision for Keahole Point. The vision is of a vibrant community of research, commercial, and educational tenants who have developed or are developing innovative methods for utilizing the natural resources available on-site. These tenants will embark on groundbreaking research and development, and will also contribute to the Hawaii economy by providing employment, investing in capital improvement, and enhancing the economic stability of the state. This vision is already manifesting itself, as the community of tenants at Keahole Point are a vibrant mix of professionals in commerce, research, and education. Our goal is to build on the existing structure and expand the size and number of tenants to utilize the entire 870 acre facility. NELHA staff are committed to supporting this vision and it shows in their teamwork and dedication to the goal.

The long-term vision for the NELHA facility was revisited during 1995 as the operating funds for NELHA were reduced due to the state fiscal crisis. In response to the Governor's request for a Program Effectiveness Evaluation Report, NELHA's chairman formed a Strategic Planning Committee (SPC) to review all aspects of NELHA, including its mission and purpose, the State of Hawaii's role in support of NELHA, NELHA's budget, the tenant's financial obligations regarding support and services provided by the State, revenue and land use projections, and NELHA's staff organization. The SPC consisted of members from both the public and private sectors who provided input from business development as well as a governmental viewpoints.



The SPC overwhelmingly agreed that NELHA was fulfilling its mission to develop and diversify the economy, with tenants to date contributing over \$25M in capital investments and over \$13M in annual cumulative sales. This equates to a total cumulative economic impact to the Hawaii State economy of over \$75M, including appropriate multipliers. The committee also agreed that in order for NELHA to truly reach its potential, additional infrastructure is needed. The committee recommended that the state continue to provide capital improvement (CIP) funds for NELHA to further the development of the facility so that it can reach its goal of self-reliance.

There are currently two facilities under the authority of NELHA: The Keahole Point Facility and the Puna Research Center (Noi' i' O Puna). NELHA is currently in the process of negotiating the transfer of the Puna Research Center to the County of Hawaii.

Today, the Keahole Point facility is the only place in the tropics where cold seawater is being pumped ashore. It is the only place where research and development are being performed on the commercial potential of deep ocean water for energy production, air conditioning, industrial cooling, cooled tropical agriculture, and a wide range of unique aquaculture projects. NELHA currently operates two deep pipelines which can pump a total of up to 15,900 gallons per minute ( $1.08 \text{ m}^3/\text{s}$ ) of seawater ashore from about 2000 ft (600 m) depth. Two surface seawater pipelines have a capacity of more than 12,600 gallons per minute ( $0.86 \text{ m}^3/\text{s}$ ). The deep seawater temperature is nearly constant at about 43 F (6C) and the surface water temperature ranges from 77F to 83F (24.5 C - 27.5 C).

Management functions for these two facilities include: operating and maintaining the infrastructure; planning and engineering capital improvements and expansion for the facilities; providing analytical laboratory services to tenants and other governmental agencies; negotiating rental and lease agreements; processing accounts receivable and payable; marketing available parcels of land, building spaces and services; and educating the community by providing materials, tours and lectures for various age groups.

This report addresses some of the significant accomplishments achieved in each of these areas during Fiscal Year 1995 (July 1, 1994- June 30, 1995).



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## OPERATIONS

The Operations and Maintenance staff of NELHA provides critical support for the facility, delivering seawater, electricity, freshwater and other services needed by our tenants. Their dedication ensures an uninterrupted supply of seawater to tenants 24 hours a day all year long. The staff includes skilled mechanics, electricians, and maintenance workers who labor together to support NELHA's mission. Many of the improvements at NELHA have been completed using the lab's "self-help" philosophy. Staff members combine their talents to complete projects that might otherwise have had to be contracted out.

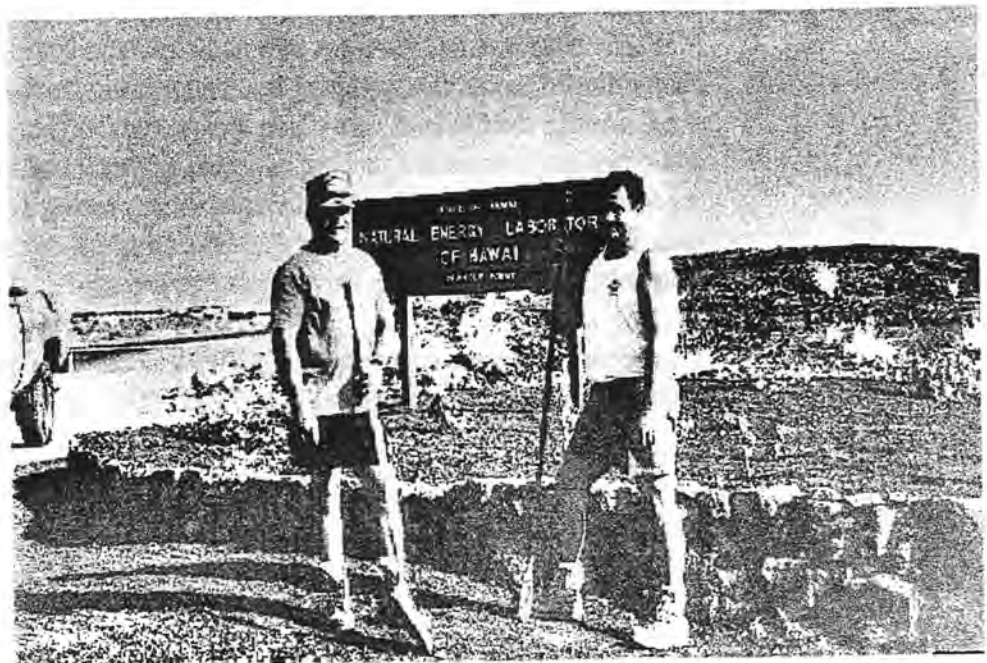
### IMPROVEMENTS TO NELHA'S RESEARCH AREAS & PONDS

One of the major accomplishments of the operations staff this year involved improvements and clean up of a twenty-two acre site previously occupied by a prior NELHA tenant. The improvements were essential to the introduction of several new tenants who took occupancy in the area this year. Improvements included the installation of new underground electric and telephone services, drainage and clean up of a lined earthen pond, the improvement of seawater and fresh water distribution pipelines, clean up of the seabottom area surrounding two offshore pump stations and the establishment of two Dept. of Agriculture approved seawater discharge wells.

### ASSISTANCE FOR NEW TENANTS LOCATING AT NELHA

Three new projects were provided assistance with the development of their facility within the Research and Farm Compounds. The apparatus from the HMTSTA open-cycle experiment completed 6 years ago was also demolished to provide space for a new closed cycle plant.

Teamwork is an essential part of NELHA's success formula, and has become even more critical following NELHA's staff reduction. A new system of "Ohana Fridays" was developed to call upon the entire staff for assistance with large projects. Below right-grounds beautification.



## **OPERATIONS**

### **ELECTRICITY SAVINGS THROUGH PUMP UPGRADES**

An outdated Westinghouse variable frequency drive (VFD) unit was replaced with an ABB computer integrated model to control more precisely the amount of water pumped to the Open Cycle OTEC project. The flexible speeds available with the new pump drives utilize less electricity and provide a significant cost savings. Three 88 hp submersible pump motors were rewound and converted to 77 hp in order to meet low pressure pumping requirements. Recovered and refurbished three pumps from an abandoned offshore pump station.

### **AESTHETIC & PRACTICAL IMPROVEMENTS AT NELHA**

NELHA groundskeepers and maintenance staff landscaped several areas within the HOST Park area as well as the entrance to NELHA itself. The newly constructed Hale He'ena laboratory building also received landscaping.

NELHA shops and shop equipment in the Administration/ Industrial Building were refurbished. A contractor was hired to rust-treat and repaint the outside and roof of the entire building.

Numerous improvements were made to the interim Visitor's Center, including the installation of new display boards, and construction of a cold and warm seawater fountain for demonstration purposes.

Telephone and signal wire conduits were upgraded along the access road.

A fuel service depot was purchased, permitted and constructed within the main NELHA compound. A two compartment concrete tank was installed for gasoline and diesel fuel dispensing to support a mobile fleet of vehicles and heavy equipment.

The analytical laboratory wet bench work area was equipped with utilities, seawater and potable water. Compressed gas and air lines were added to support the requirements of various items of analytical equipment.

A telephone service and pay phone unit were installed at the NELHA beach and restroom complex. Electric power and potable water were connected to a new storage building.

A 15 ton, 4-wheel-drive hydraulic crane was rebuilt and refurbished.

The installation of a new facility alarm and control system was facilitated through the installation of 4,500 ft of signal cable from the 24-in surface seawater pump station to the Administration Building and to the main pump control building.

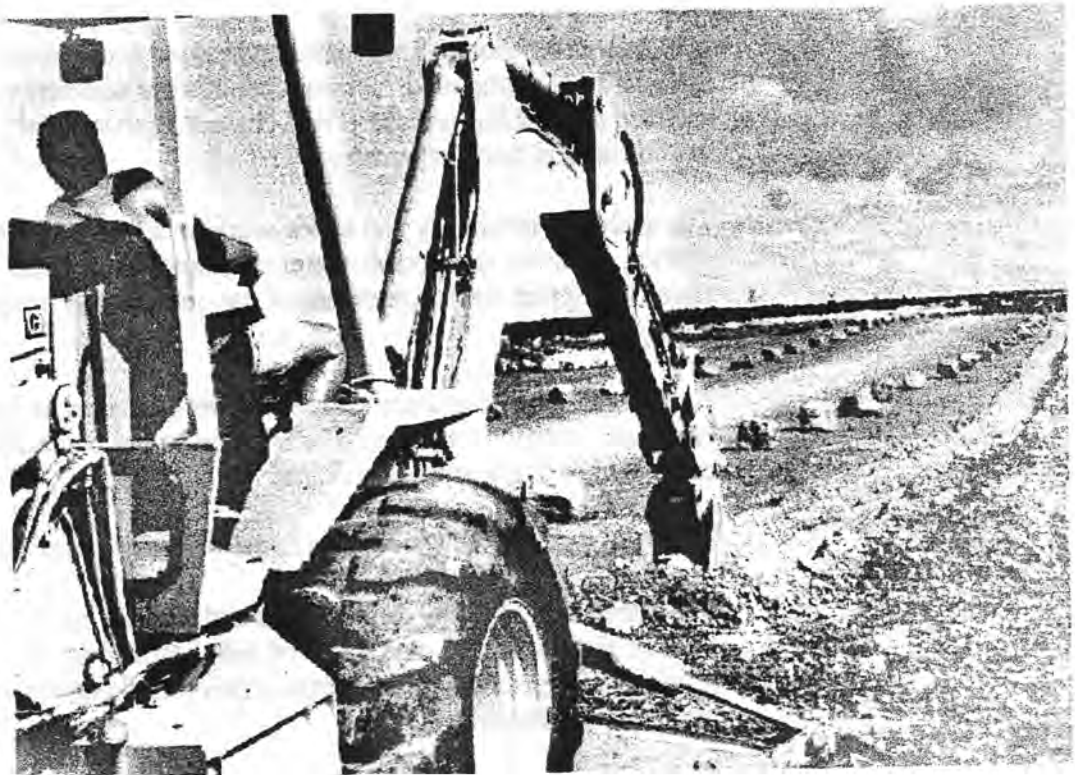
## ENGINEERING

### Microtunneling:

The biggest engineering project of this year has been the shoreline crossing which is the first component of the installation of new surface and deep seawater pipelines designed to serve projects in the HOST Park area. NELHA's contractor, NOVA Group, Inc. of Napa, California, is constructing two parallel 66-in diameter tunnels which will extend from 30 ft deep in a pump station 460 ft onshore to a breakout through the seafloor 540 ft offshore at a depth of 80 ft.

The contractor is using "micro-tunneling" technology, in which an autonomous tunneling machine is pushed into the tunnel by large jacks mounted in a dry pit. A 50-ft deep "launching shaft" has been constructed about 5 ft back from the coastline and is lined with "sheet piles" so that it can be "dewatered". The contractor has completed two tunnels onshore from this launching shaft to a 30-ft deep reception shaft 460 ft back from the water. Early this fall they will begin tunneling the two offshore tunnels which will then be joined in the launching shaft with the onshore sections. The launching shaft will then be back-filled, leaving no permanent disruption at the shoreline. Though the project is behind schedule and the contractor is significantly over budget, NELHA has a fixed price contract and the funding for the follow-on pipeline installation is indefinitely delayed. Fortunately, the contractor has committed to continuing the work, which is now scheduled for completion in March, 1996.

NELHA's skilled staff are capable of completing many of the engineering and operational projects of the facility on a "self-help" basis.



## ENGINEERING

Micro-tunneling appears to provide a cost-effective, environmentally benign mechanism for bringing large pipelines through the shoreline area. Alternative solutions, including above-ground pipelines, trenching and directional drilling are much more costly and/or more harmful to the environment. Micro-tunneling will allow us to bring large pipelines ashore with no permanent disturbance of the shoreline area. Plans actually call for establishing a public beach park over the area where the pipelines pass under the shoreline.

This project will provide the shore crossings for the two pipelines which are needed to serve the large land area set aside for the HOST Park. They will initially provide the large volumes of water needed to operate an OTEC plant to be constructed by KAD Partners. This plant will provide electricity to pump the water to the rest of the KAD Partners projects and also to other users in the NELHA facility. NELHA is requesting capital improvement funds to allow completion of the whole pipeline system in the next biennium. This is the most important step towards allowing the full utilization of NELHA's facilities at Keahole Point.

### Sea Water Systems:

Following completion of the preliminary design for NELHA's new 55-in diameter HOST Park pipelines, the continuing engineering services contract with Makai Ocean Engineering, Inc. (M.O.E.) of Waimanalo Oahu has dealt with five tasks this year:

- 1) Engineering oversight of the NOVA Group, Inc. contract for installation of the micro-tunnel shore crossing for the planned HOST Park 55-in diameter pipelines. M.O.E. has provided consultant engineering services, acting as NELHA's engineer for this project.
- 2) Planning and oversight of the submersible dives required to complete the design of the 55-in diameter pipelines. M.O.E. personnel will serve as engineering observers on the dives, which are scheduled for mid-October, 1995.
- 3) Conceptual design of the seawater distribution systems for the HOST Park area. M.O.E. continues to provide guidance and engineering assistance to the development of plans for distributing the water from the 55-in diameter pipelines throughout the HOST Park area. They are working with civil engineering consultants, Reid and Associates, Inc., who are designing the access roads and utilities for the area.



## ENGINEERING

4) Review and upgrade design of existing onshore seawater distribution systems. The NELHA onshore seawater distribution systems have grown piecemeal to meet changing demands over the last 15 years, so the existing system is unnecessarily complex and inefficient. M.O.E. engineers are working with NELHA personnel to develop and implement a simpler yet more flexible system.

5) Review of situation and recommendations for utilization of existing offshore seawater pipelines. M.O.E. is examining alternative uses for the six pipelines (none now operational) which NELHA acquired following the bankruptcy of Ocean Farms of Hawaii. Though these lines were all installed for pumping deep seawater, their diameters are too small to do so efficiently and several of them have additional mechanical problems. Possible alternatives which M.O.E. is investigating include: pumping of surface seawater, back-up to other deep seawater pipes or for discharge of used seawater below the 100 fathom depth where it will have negligible environmental impact. Preparation of the report for this task will require data from the submersible dives now scheduled for November 1995.

### Submersible dives:

NELHA has contracted with the Hawaii Undersea Research Laboratory of the University of Hawaii at Manoa to provide their PISCES V submersible for a series of five dives, two surveying the intended route of NELHA's new 55-in diameter pipelines and three inspecting the nine existing deep seawater pipelines. These dives, originally scheduled for late 1994, have been repeatedly delayed by problems with implementing HURL's new support ship. The dives are now scheduled for late November 1995 using the old "LRT" (Launch, recovery and transport) vehicle which was used before the new support ship was designed. These dives will provide vital information for the final design of the new 55-in diameter pipelines, important operational information on the state of the presently operating pipeline systems, and needed information on the status of the six non-operating pipelines obtained from Ocean Farms of Hawaii.

### Access Road and Utilities Design:

Reid and Associates, Inc. of Kailua-Kona has contracted with NELHA to provide civil engineering design services for the access roads and utilities for the build-out of NELHA's HOST Park area. The contractor is also working to clarify the subdivision and planned unit development processes for NELHA land. In addition, the contract includes tasks for the final design of NELHA's emergency generator system and for the provision of access and utilities to the presently inaccessible northern section of the NELHA property.

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## ANALYTICAL LABORATORY



The water at Keahole Point is the best-monitored ocean water in the state, and perhaps in the nation. As the ocean water is NELHA's most important resource, it is vital that we ensure that its quality remains pristine. NELHA's environmental impact statement requires a Comprehensive Environmental Monitoring Program (CEMP) which is conducted by NELHA chemists and microbiologists.

NELHA's Analytical Laboratory collects and disseminates the information needed to protect our valuable seawater and groundwater resources. This laboratory is well equipped for the task and has established a forward-looking multi-disciplinary environmental monitoring team. Some highlights of this year's efforts include:

A full year of NELHA's Comprehensive Environmental Monitoring Program (CEMP) was completed, and all quarterly reports were submitted on time.

Analytical services were provided to many tenants, including Black Pearls, Inc., Cyanotech Inc., Uwajima Fisheries, Inc. and Aquaculture Technology, Inc.

Though reduced funding forced curtailment of contract work in chemistry and bacteriology on the State Department of Health Blue Waters Monitoring Program, some work was continued during this year..

Facilities and personnel training were upgraded to prepare for expanded contract work for the State Department of Transportation on the Keahole Airport Expansion environmental monitoring program.

The Analytical Laboratory provided another full year of analyses of environmental samples from Penrhyn Atoll in the Cook Islands. The U.S. Agency for International Development is funding this project to promote the development of pearl farming.

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## ADMINISTRATION

NELHA's administrative staff provides fiscal, contracts, personnel, marketing, clerical, public relations, and educational support to the facility. The small staff works closely with the Board of Directors, DBEDT and other government agencies to fulfill NELHA's many reporting requirements. Their interaction with potential tenants, current tenants, and the general public assists in progress toward NELHA's goals of increasing the number of tenants at the facility and educating the public about the resources and achievements of NELHA.

### CONTRACTS AND PERMITTING

- A Program Effectiveness Evaluation Report for NELHA was submitted in response to a Governor's memo of March 10, 1995 which requested proposals and a time frame for making NELHA more self-reliant and less reliant on general fund and general obligation bond fund support.

To respond to the Governor's request, the Chairman of the NELHA Board of Directors formed a Strategic Planning Committee consisting of 14 members, of which half were from the private sector, to completely review NELHA's mission, operations and organization.

The SPC completed their analyses and deliberations in July 1995.

(See SPC report for more information.)

- Eight leases and Facilities Use Agreements were negotiated and executed with several different tenants.
- Contracts for offshore biota monitoring and for the refurbishment of the NELHA administrative building were completed. Four other capital and systems improvement contracts are in progress.

## ADMINISTRATION

### FISCAL OFFICE

The NELHA fiscal staff works closely with the State of Hawaii Department of Budget and Finance, the Department of Accounting and General Services, and DBEDT to manage the financial resources of NELHA. Due to the state fiscal crisis, this year was more critical than usual. In addition to responding to the many reporting requirements of the state, the NELHA fiscal office was instrumental in assisting the facility through significant budget revisions required this past fiscal year. Among the fiscal office's other accomplishments are:

- Implementation of a Budget & Purchasing Guide
- Provision of an informational meeting and tour for Budget & Finance staff to clarify the requirements of NELHA's CIP requests
- Completion of the first report to OHA on ceded land payments
- Standardization of input on revenue and reporting with the Keahole Point Association





# ADMINISTRATION

## MARKETING

With the goal of becoming more self-sustaining and less reliant on state general funds for operating expenses, a greater emphasis has been placed on marketing the facilities and resources at NELHA to potential tenants.

The initial stage of NELHA's revitalized marketing program was the development of a marketing plan, which was completed and approved by the NELHA Board of Directors in January 1995. Due to the state fiscal crisis some of the promotional strategies outlined in the marketing plan could not be initiated. NELHA uses many of the traditional marketing methods, such as advertising and cold calls, to reach potential tenants but some less traditional means are also used to market the facility, including:

- publishing a NELHA newsletter for distribution to potential tenants, media, professionals, government officials, and other interested parties.
- utilizing electronic networks such as listservs and newsgroups to reach potential tenants
- establishing a world wide web page for NELHA.  
**The URL is <http://bigisland.com/nelha>**
- networking with public and private agencies and individuals throughout the state in order to reach potential tenants
- working with other state agencies to ensure NELHA representation at the World Aquaculture Conference and the Oceans/MTS conference
- partnering with other organizations such as DBEDT's Energy Division and the UH-Hilo Small Business Development Center to co-sponsor workshops and seminars to be hosted at NELHA
- establishing a database of potential tenant contacts

Fostering awareness of successful enterprises already flourishing at NELHA is one avenue the facility utilizes to market its resources and the support it provides to potential new tenants.



## ADMINISTRATION

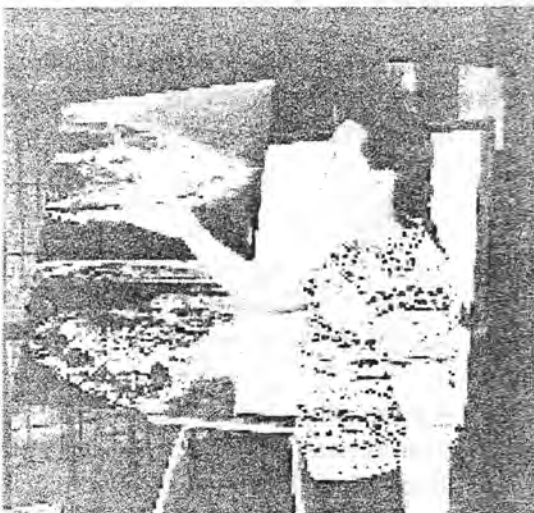
### PUBLIC RELATIONS & PUBLIC EDUCATION

Each year, NELHA hosts numerous visitors who are intrigued by the facility's pioneering efforts in Ocean Thermal Energy Conversion and related aquaculture development. Over 4,300 school children and 2,000 adult visitors came to Keahole Point to learn about the facility and its resources this year. Some visitors came to NELHA for the free public presentation held each week. Others traveled to NELHA as part of a school or special interest group. Children were able to learn first hand about Hawaii's resources and environment and how important they are to the future of the state.

Some extra-curricular events attracted additional members of the community to Keahole Point. The third annual Open House held during Energy Awareness Month in October was a great success and brought hundreds of individuals to the facility. NELHA also participated in the 25th anniversary of Earth Day during the month of April by hosting a series of events at the facility. Lectures, a beach clean-up, and a Chamber of Commerce "After Hours" event brought the Kona community to Keahole Point. The "After Hours" featured pupus prepared courtesy of Chef Glen Alos of Kona Village Resort, utilizing products of NELHA tenants

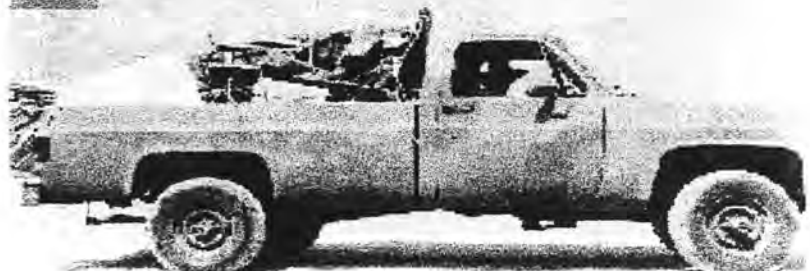
NELHA representatives also attended several career fairs and local festivals promoting the Keahole Point facility.

Media interest in NELHA remained high this year with numerous organizations publishing articles or airing stories about NELHA. Popular Science, Nebraska Public Television, China Television Company, French National Television, and many others featured NELHA in their stories.



During NELHA's annual open house, the entire staff participates, providing visitors an in-depth look into the operations and achievements of the facility. (left)

NELHA staff removed truckloads of trash from the coastline during an Earth Day beach clean-up. (right)



# ADMINISTRATION

## PERSONNEL

- Training Program Plan- A formal employee development/ training plan was drafted and approved by the NELHA Board of Directors in February 1995.

- New Employees-

Robert Kihune, Executive Director  
(August 1994)

Karin Haleamau, Groundskeeper II  
(Nov. 1994)

Adrianne Greenlees, Public Information  
Specialist (Nov. 1994)

Eugene Pierce, Electrician II (July 1994)

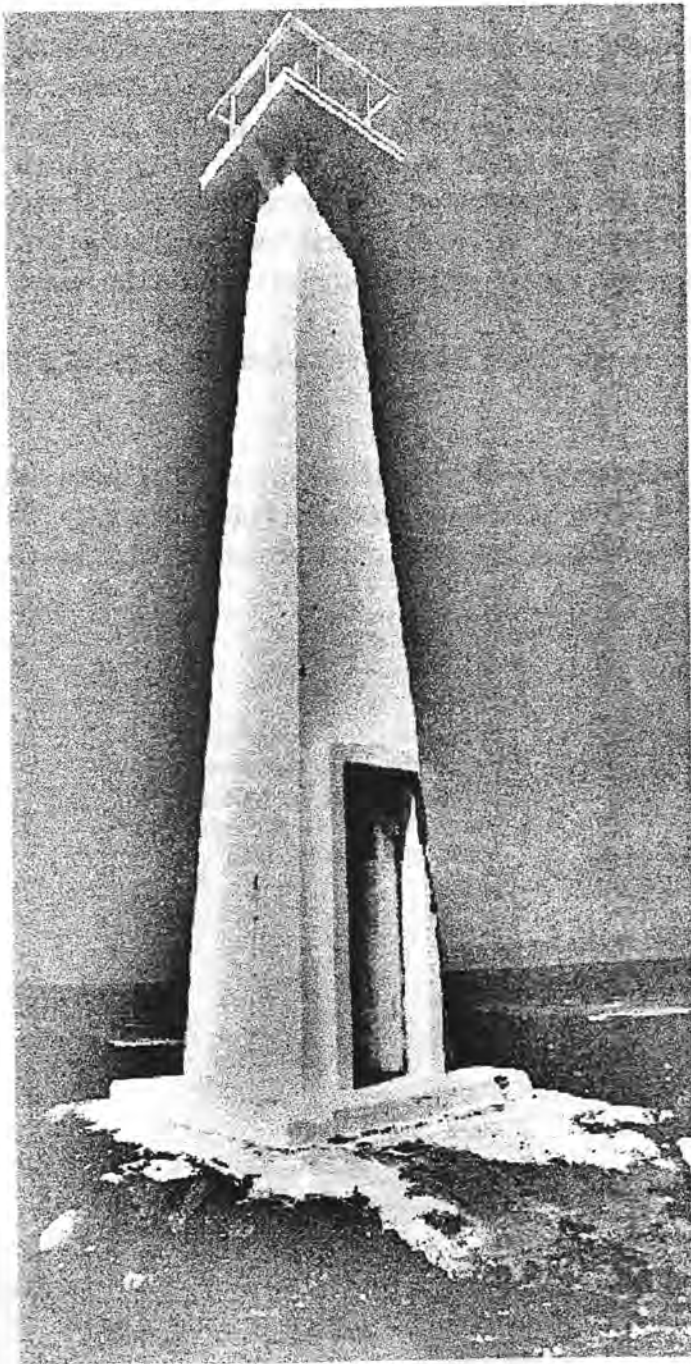
- Reorganization- A reorganization plan was submitted to DBEDT in October 1994. Due to administration changeover, the reorganization proposal was cancelled. A new organizational structure has been proposed due to NELHA's recent downsizing.

- Budget cuts necessitated the abolishment of vacant funded positions, and dictated a determination of filled positions to be terminated in FY96.

### Board of Directors:

- Farewell to Sidney "Bill" Cook, whose four year term as the Governor's appointee to the Board ended on June 30, 1995.

- The new Governor's appointee is Steven Chu, from the State Attorney General's office.

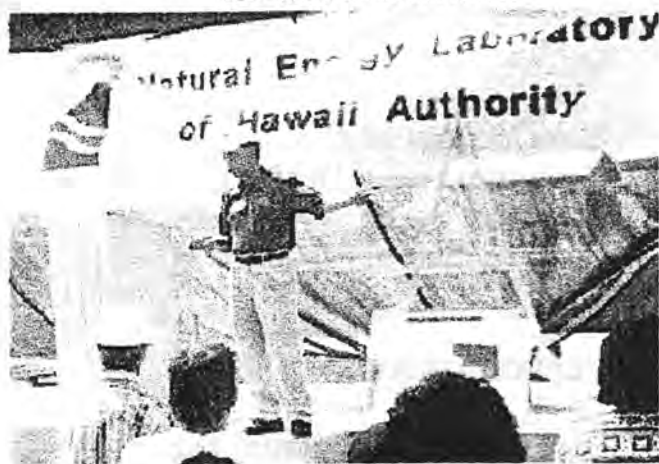


## **ADDITIONAL ACTIVITIES AND ACCOMPLISHMENTS AT NELHA**

### **"COLLOID COOKOFF"**

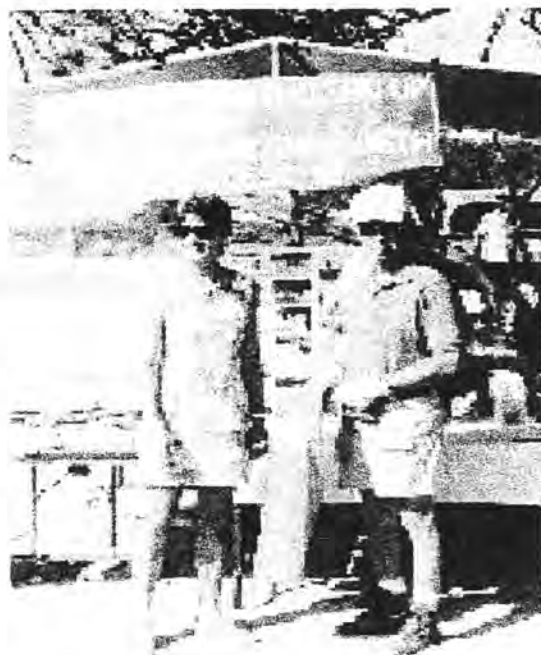
Twenty-one scientists from across the United States traveled to the Big Island in January to collect colloids in the water pumped up at NELHA. Colloids are gelatinous material that contain a significant fraction of the organic and inorganic matter in the ocean water. Experimental results have varied widely in the past because of the difficulty of collecting and analyzing the colloidal material. NELHA made a perfect site for the week-long experiment because of the large amounts of cold and warm seawater pumped ashore at the facility.

NELHA has received very positive feedback from the group which is impressed with the staff, support and facilities. All of the scientists, who came from eleven different institutions, have said they hope to return to NELHA for research in the future.



### **DBEDT MANAGER OF THE YEAR**

Robert K.U. Kihune was chosen as DBEDT's Manager of the Year for July 1994-June 1995. "Bob" served as NELHA's Executive Director this past year, bringing new energy and vision to the Laboratory. His guidance was instrumental throughout NELHA's downsizing and strategic planning process. Bob's "hands-on" management style helped build rapport among the NELHA staff. Above he is pictured providing presentations to the public during NELHA's Annual Open House. Bob also donned gloves to help beautify the coastline at Keahole Point during NELHA's Earth Day Beach clean-up (right).





# **NELHA SERVICES**

## **OPERATIONS and MAINTENANCE**

Seawater Systems  
Equipment Rental and Repairs  
Heavy Equipment Operators  
Mechanical Technicians  
Diving, Plumbing, Welding  
Metal and Wood Shop  
Fabrications  
Automotive Repairs  
Marine Operations

## **ENGINEERING**

Piping Design  
Site Development  
Computer Aided Drafting  
Electrical Systems Analysis  
Construction of Structures

## **ANALYTICAL LABORATORY**

Certified Environmental Lab  
Environmental Monitoring Services  
Chemical Analysis  
Microbiological Analysis  
Microbiological Reference Library  
Technical Assistance

## **ADMINISTRATION**

Clerical Assistance  
Leases and Service Contracts  
Telecommunication Support  
Fiscal Support  
Graphic Design  
Educational Programs  
Business Development & Marketing Assistance

## NELHA TENANTS

## NELHA TENANTS

NELHA exists because of the tenants who lease land and utilize resources available at Keahole Point to engage in a variety of activities. The individuals who are involved in the various research, commercial and educational activities at NELHA are leaders in their fields. A number of them are known world-wide for their efforts. Their expertise is breaking new ground in areas of alternate energy production, mass algae production, aquaculture, agriculture, astrophysics, natural antibiotic development and other key areas of research.



ATI raises shrimp and oysters at NELHA.

Their economic impact on the local economy is in excess of \$17 million annually.

These pioneers are setting the pace for the world. They are the first of what NELHA hopes will be a fully developed ocean science and technology community at Keahole Point.

**Aquaculture Technology, Inc. (ATI)** produces blue shrimp and american and pacific oysters. They continue to investigate the commercial co-production of marine shrimp and oysters in a symbiotic system. The design reduces the amount of labor needed while increasing the product output.

**Aquasearch Inc.** is a marine biotechnology company aimed at sustainable development of the ocean's resources through the production of microalgae. The company was formed by a group of scientists at the Scripps Institution of Oceanography in La Jolla, California, who have created a new technology for mass production of microalgae in a closed system. The initial product of Aquasearch is astaxanthin, a natural pigment produced from microalgae that gives shrimp and salmon their characteristic pink color.

Through their first contract, Aquasearch will provide astaxanthin to a European poultry feed supplier to provide natural pigmentation for egg yolks.

**Black Pearls Inc.** is developing the technology to grow black-lip pearl oysters, *Pinctada margaritifera*, and produce valuable black pearls in Hawaii and other islands in the South Pacific. Following successful hatchery development, they are now investigating the feasibility of commercial pearl farming in Hawaii using land- and ocean-based systems. They have

## NELHA TENANTS

also developed a remote quarantine hatchery system which now allows expansion of pearl farming into many islands in the Pacific. Broodstock are flown to the hatchery, spawned, and the larvae are then reared under state-approved quarantine conditions. Once the spat settle, they are flown back to the farm site. The first pearl farm with this type of operation has been set up in the Marshall Islands, with plans to expand to islands in Kiribati.

**Common Heritage Corporation (CHC)**, is dedicated to manage, whenever and wherever it can, those environmentally sustainable innovations in ocean technology which will redound to the benefit of the world community of human beings. One such innovation is the new field of coldwater agriculture, which uses deep seawater as a coolant to manipulate soil and air temperatures. Agriculture species that otherwise could not thrive in the coastal desert can now be successfully grown. Common Heritage maintains a coldwater demonstration garden at NELHA in which over 100 species of high value food crops such as strawberries, asparagus, artichokes, basil and gourmet lettuces have thrived. If you have internet access, you can reach CHC at:  
<http://www.aloha.com/~craven>

**Cultured Technologies Inc.** is involved in research of a number of aquaculture species, with primary emphasis presently on the pearl oyster.

**Cyanotech Corporation** is a leader in marine biotechnology, using proprietary production and processing systems to produce algal products for worldwide nutritional and pharmaceutical markets. The Company's current products include Spirulina Pacifica, a high protein nutritional product, and phycobiliproteins, fluorescent pigments used in immunological diagnostics. Nutrex, Inc., the Company's wholly-owned subsidiary, produces and markets a line of Spirulina-based nutritional products for the retail consumer market. Cyanotech is also developing commercial microalgal production systems for beta-carotene, an antioxidant supplement which studies have shown to reduce the risk of cancer and heart disease; astaxanthin, a natural red food pigment used in the salmon aquaculture industry to impart a natural pink color to salmon flesh; and a microalgae which kills mosquitoes.

**DUMAND**, the Deep Underwater Muon and Neutrino Detector, is a project uniting high energy particle physics scientists from the United States, Japan and Europe. Exploring a new field called high energy neutrino astrophysics, they will collect data on subatomic particles. The scientists are deploying an array of sensors more than three miles deep in the ocean to detect neutrinos and other particles which pass through the earth and the ocean. Analysis will provide a better understanding of the stellar reactions which produce these particles.



Cyanotech's wholly owned subsidiary, Nutrex produces spirulina tablets for the health food supplements market.



## NELHA TENANTS

**Hawaiian Bred Tropicals** is involved in research to perfect breeding techniques for ornamental reef fish. Their success will help to supply the commercial aquarium market, reducing its current pressure on the natural reef population.

**Indo-Pacific Sea Farms (IPSF)** is developing new technology to cultivate photosynthetic invertebrates such as giant tridacnid clams and other benthic coral reef species for the marine aquarium trade. Photosynthetic marine invertebrates derive their nutrition from their association with microscopic, endosymbiotic algae called zooxanthellae. Cultivation requirements for the plant-animal consortium are similar to those of free-living microalgae, and include bright sunlight, warm surface seawater and a carefully controlled concentration of deep seawater to supplement essential inorganic nutrients, primarily nitrogen and phosphorus. No commercial feeds are used and no pollution is produced with this novel approach. Sustainable farming of photosynthetic coral reef species helps reduce harvesting pressure on threatened wild stocks while providing a stable supply of high-quality product for the marine aquarium trade.

**Island Traders, Inc.** uses the abundant sunshine at Keahole Point to produce sun-dried fish jerky. The fish jerky is prepared from locally caught fish, marinated in a hot-n-spicy or mild teriyaki seasoning and dehydrated with the use of specially designed solar drying units. Island Traders is producing its product in a shorter time than standard methods and without the use of electricity.

**Kona Cold Lobsters Ltd (KCL)**, imports live Maine lobsters and rejuvenates them using deep seawater. A typical air shipment from Maine to Keahole Point has the lobsters out of the water for 24-30 hours. Lobsters are inspected, weighed and fed before being distributed to customers throughout the Hawaiian Islands and select Asian destinations. KCL also grows Maine lobsters from eggs to market size on a prototype scale. This research is multidisciplinary involving reproduction, husbandry, nutrition, pathology and habitat design.



Kona Cold Lobsters Ltd. has proven that with the cold water resource available at NELHA, they can provide a year-round supply of healthy lobsters to markets across Hawaii and the Pacific Rim.

## NELHA TENANTS

**Marine Science Research Center (MSRC)**, from the State University of New York at Stony Brook, is investigating the feeding activity of a group of planktonic animals, collectively called copepods. Living in the surface and deep seawater, copepods form an important link in the marine food web by passing nutrients from single cell plant life to populations of larger animals such as fish. However, the animals small size (<2mm) offers a considerable challenge to this study. Using a high magnification video optics setup constructed with He-Ne laser illumination, the MSRC researchers are able to observe and quantify the feeding behavior of these animals and their responses to fish predation. Funding is provided by the National Science Foundation and the Office of Naval Research.

**Ono Take Corporation**, is a research corporation investigating the cultivation of shitake and other mushrooms. The focus of this research is on the use of temperature control to optimize the yield of mushrooms. Cold seawater allows Ono Take to manipulate precisely the micro-climate of the grow house, creating appropriate environments for each stage of fungal development.

**Pacific International Center for High Technology Research (PICHTR)**. PICHTR's 210 kW open-cycle OTEC facility has successfully operated this past year. The primary objective is to continue operation of the plant to gather life cycle data for the major components (turbine and high speed vacuum compressors) and acquire experience in the operation of OTEC plants for the production of electricity and desalinated water. Another objective is to continue dissemination of the knowledge acquired by publishing articles in professional journals and interacting with the general public during tours of the facility. The experimental program has been sponsored by the federal government and the State of Hawaii. The open-cycle OTEC plant has produced up to 255 kilowatts (kW), using 150 kW to operate the plant and resulting in up to 100 kW of usable electrical power and 7,000 gallons of fresh (desalinated) water per day. These are

"The Natural Energy Lab is an excellent example of industry and business working in harmony with the environment."

Gerald Cysewski, President  
Cyanotech Corporation

world records for OTEC. With funding from the State of Hawaii, the Hawaii Electric Company, and the Advanced Research Project Agency of the U.S. Department of Defense, PICHTR plans to complete a 50 kW Closed Cycle OTEC experimental apparatus in 1996. The project will test Roll-bonded aluminum heat exchangers manufactured by

ALGOODS as well as the generation and supply of electricity to the NELHA grid. It will also demonstrate the feasibility of mariculture projects downstream from an operating closed cycle OTEC plant by monitoring the quality of the seawater discharge. This experimental plant will provide baseline operational experience with potentially low cost aluminum heat exchangers and data for the design of larger OTEC systems.

## NELHA TENANTS

**Royal Hawaiian Sea Farms, Inc.** has been in business since 1987 and commercially produces limu, or edible sea vegetables. Sales of these popular nutritious delicacies have consistently reached over a ton per week. A pickled ogo (**Gracilaria**) product is being processed under the "Waimanalo Ko-Ko" brand. In addition to limu, RHSF also produces salt water tilapia (**Tilapia**) and milkfish (**Chanos**). Intensive applied research is being conducted to investigate the potential of commercially producing edible sea cucumbers (**Stichopus**), the Hawaiian limpet- opihi (**Cellana**), and warm water abalone (**Haliotis**).

"It's hard to imagine in the winter time that you can open a valve and have warm water 24-hours a day, but that's exactly what we have here."

Mark Weigardt, Taylor United

**SeaTech Contracting, Inc.** is a general and environmental contracting/marine construction company with an emphasis in commercial diving. They were the first support company to locate at Keahole Point and provide highly skilled services to NELHA, its tenants and companies in the surrounding

area. Seatech's skills center around underwater surveys, underwater piping and pumping systems, dredging, drilling and salvage.

**Taylor United Inc.** is a family owned and operated shellfish company with its headquarters in Shelton, Washington. Their manila clam and pacific oyster nursery at NELHA serves for only a small segment of the life of the juvenile shellfish. They raise the larvae in their hatchery facilities in Washington and send them to Hawaii just after they have settled out of their swimming cycle. At this stage they are about 250 microns in size. At the NELHA facility, Taylor United raises the shellfish up to 5 mm size on screens and in sand raceways. They are then shipped back to the Pacific Northwest for growout. The cold and the warm seawater provided by NELHA are utilized to achieve exact temperatures needed for shellfish growout, and the year round warm climate allows a year-round growing season for the shellfish. Future plans include an expansion of their nursery in order to produce 100 million juvenile clams and 6 million juvenile oysters in the next year.

**Uwajima Fisheries, Inc. (UFI)** has developed a facility for growing hirame, a flounder highly prized by the Japanese for sashimi. Uwajima Fisheries markets their 1 1/2 to 2 lb hirame through a local Honolulu distributor. UFI manages the maturation and spawning of their broodstock for year round production of eggs. UFI utilizes the NELHA surface and cold deep seawater for the semi-intensive polyculture of marine shrimp, milkfish and ogo. With this system they are currently producing a high quality superior product. This company also experimented with white shrimp, *P. vannamei*, utilizing strict Specific Pathogen Free quarantine protocol. They are currently marketing certified pathogen free broodstock throughout the mainland USA and Central and South America. UFI has also experimented in broodstock management, spawning, larval rearing and growout of Pacific Threadfin (Moi).

## NELHA TENANTS



Students from the West Hawaii Explorations Academy provided educational tours to younger students during 1995. The program helped the high school students practice communication skills while providing the younger students with positive role models to emulate.

**The University of Kiel** has conducted experiments on optimizing the production of hydrogen by photovoltaic electrolysis of seawater using inexpensive components. They have also performed research on the extraction of trace elements of heavy metals from seawater.

**West Hawaii Explorations Academy**, is an integrative learning laboratory, sponsored by the State Department of Education for Kona's secondary students. Tenth through Twelfth grade students work and study full-time at Keahole Point throughout the school year. They collaboratively team with peers, staff, mentors, community members and employers. Rather than attending classes, students receive credit for working on projects which may include aquaculture and cold water agriculture, alternative energy development, alternative vehicle research, and learning about marine environments. Also included in the program is a major school-to-work component, including a full-time vocational counselor. After initial training, students are encouraged to take on NELHA tenant research projects or seek part-time employment at one of the Keahole Point enterprises.



**NEED A FINDER? SEARCH**

## STATEMENT OF OPERATIONS

(For the period July 1, 1994- June 30, 1995)

### REVENUES

#### General Funds

|             |                       |
|-------------|-----------------------|
| State Funds | <u>\$2,527,443.00</u> |
| Subtotal    | <u>\$2,527,443.00</u> |

#### Special Funds

|                       |                   |
|-----------------------|-------------------|
| Land Use Fees         | \$195,751.92      |
| Reimbursables         | \$439,878.20      |
| Other Projects        | \$5,357.00        |
| Interest Received     | \$23,590.65       |
| Vending Machine Sales | \$773.26          |
| T-Shirt Sales         | \$529.75          |
| Percentage Rents      | <u>\$2,331.91</u> |

Subtotal \$668,212.69

Total Revenue \$3,195,655.69

### EXPENDITURES

#### General Funds

|                 |                    |
|-----------------|--------------------|
| Salaries        | \$1,090,327.67     |
| Kona Operations | \$996,028.37       |
| Puna Operations | <u>\$15,046.85</u> |

Subtotal \$2,101,402.89

#### Special Funds

|                                                                                                  |                    |
|--------------------------------------------------------------------------------------------------|--------------------|
| In the 1994 Legislative Session,<br>NELHA was given no authority<br>to spend their Special Fund. |                    |
| *Ceded land Payments /journalled                                                                 | <u>\$45,665.08</u> |

Total Expenditures \$2,147,067.97

## FINANCIAL POSITION

|                                                       |                       |
|-------------------------------------------------------|-----------------------|
| Special Fund Balance July 1, 1994                     | \$273,744.12          |
| State General Fund Appropriations                     | \$2,527,443.00        |
| Special Fund Revenues                                 | \$668,212.69          |
| Unrequired Balance from S/F CIP                       | \$145,108.08          |
| Unrequired Balance from S/F Contracts                 | <u>\$4,618.40</u>     |
|                                                       | <u>\$3,619,126.29</u> |
| General Fund Expenditures                             | \$2,101,402.89        |
| Special Fund Expenditures/journal entries \$45,665.08 |                       |
| Unrequired G/F Returned to St Treasury/DBEDT          | <u>\$426,040.11</u>   |
| Ending Special Fund Balance 6/30/95                   | <u>\$1,046,018.21</u> |

## PROJECT APPLICATION PROCEDURES

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## **Project Application Procedures**

NELHA welcomes applications from individuals, businesses, research organizations, and educational facilities desiring to perform research and/or development activities. NELHA recommends that those individuals or businesses interested in beginning a commercial enterprise first complete research and development at NELHA to evaluate the feasibility of the activity.

### **Assessment Criteria**

NELHA is governed by a nine member board of directors which must give final approval to all project proposals. Initially, all proposals must meet established criteria:

- a. Projects which promise to accomplish a measurable impact in a specific area and for the purpose for which the applicant requested.
- b. Projects that are consistent with NELHA's identified fields of interest - alternate energy, aquaculture, biotechnology, and other fields which utilize deep or surface seawater, or high solar insolation.
- c. Exemplary organizations with a history of achievements, technical expertise and good management.
- d. Projects that demonstrate a stable financial condition supported by current and full, certified, audited financial statements [commercial projects only].

### **Project Initiation Procedure**

Interested parties will be provided with the Project Initiation Packet which details the process required to establish a project at NELHA.



## **PAST RESEARCH PROJECTS**

- **Keahole Point**
- **Puna Research Center**

## **PUBLICATIONS**

- **Keahole Point**
- **Puna Research Center**

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## Past Research Projects at Keahole Point

### \* MINI-OTEC DEMONSTRATION - ( 01/79 to 12/79)

FUNDING SOURCE - State of Hawaii

Demonstrated net power production from closed-cycle OTEC. Generated > 10 Kw net electricity on a floating platform moored in the NELH Offshore Research Corridor.

### \* ARGONNE TEST PROJECT - ( 07/81 TO 09/87)

FUNDING SOURCE - DOE/DPED, DOE funding via SERI after 07/83

Studied heat transfer variations, biofouling control measures for closed-cycle OTEC, researched corrosion of candidate heat exchanger materials and analyzed incoming seawater. Found that biofouling in warm seawater repeatedly reduces heat transfer to unacceptable level within 20 days. Chlorine levels as low as 70 ppb for 1 hr/day found to control the problem. Aluminum alloys show pitting corrosion in cold seawater, but not in the warm seawater. Cladding eliminates cold seawater pitting.

### \* OTEC AQUACULTURE: TROUT AND SALMON - (01/82 to 11/84)

FUNDING SOURCE - UHSG, MAC, DPED

Investigation on growing salmon and trout yielded >0.5 lb fish per gallon per minute of deep seawater. It identified optimum temperatures, photoperiods, flow rates and studied smoltification parameters for salmon. First to spawn trout successfully in seawater.

### \* OTEC CHLORINATION - (06/82 to 06/83)

FUNDING SOURCE - HNEI

Investigated the effects of low level chlorination on the marine food chain. Found that in tropical seawater chlorine kinetics differ markedly from other seawater, the required concentration of the chlorine is much less than in temperate water, and only trace levels of halogenated organics are produced in chlorinated tropical seawater.

### \* ALCOA CORROSION - (01/83 to 01/85)

FUNDING SOURCE - Alcoa

Studied the effects of corrosion in flowing seawater and the effects of brushing in warm and cold seawater on various aluminum alloys.

### \* HEAT AND MASS TRANSFER RESEARCH - (06/83 to 12/90)

FUNDING SOURCE - SERI/DOE, PICHTR

Efficiency of spout evaporators and condensers in a seawater system are similar to those found using freshwater in Colorado tests. They promise high efficiency, however, for open-cycle OTEC.

### \* GAS DESORPTION RESEARCH - (06/83 to 06/84)

FUNDING SOURCE - SERI/ORNL/DOE

Used a packed column to study composition and removal of dissolved gases in seawater at various temperatures and pressures. The height of transfer units which measure the power required to remove dissolved gases are about 50% less with seawater than predicted from freshwater data.

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## Past Research Projects at Keahole Point

\* MIST-LIFT PROCESS - (06/83 to 12/83)

FUNDING SOURCE - SERI/DOE

Mist generator with seawater works well without clogging, and the vapor-mist coupling may provide up to 100 m of lift from 20 C T.

\* CWP/AST PHASE III - (04/83 to 05/85)

FUNDING SOURCE - NOAA/DOE

Deployed and monitored an 8-ft. diameter Fiberglass reinforced plastic (frp) cold-water pipeline down a slope off Keahole Point. Data were collected on forces on the pipe and its foundation under varying environmental conditions.

\* OTEC AGRICULTURE - (01/84 to 6/84)

FUNDING SOURCE - UHSG

Grew Strawberries and various vegetables with freshwater condensing on pipes carrying cold seawater. Seasonal cycling can also be achieved by controlling the water flow rate.

\* GIANT CLAM CULTURE - (08/85 to 08/86)

FUNDING SOURCE - Marine Animal Associates/Waikiki Aquarium

Studied the growth of giant clams (Tridachnidae spp.) in the Hawaiian environment.

\* OPIHI CULTURE - (10/86 to 01/89)

FUNDING SOURCE - W.H. Magruder

Investigation and demonstration of opihi (Hawaiian limpets) growth. Opihi reproduced and grew well in sprays of deep seawater.

\* MACROALGAE INVESTIGATION - (05/86 to 01/87)

FUNDING SOURCE - HNEI, ADP

Investigated the use of macroalgae to remove most of the excess nutrients from return seawater at NELH. Algal mats were found to be effective.

\* PHYTOPLANKTON STUDY - (09/86 to 09/87)

FUNDING SOURCE - Office of Naval Research

Studied the occurrence of a symbiotic cyanobacterium in the cells of certain diatom populations in surface seawater.

\* ALGAE CO<sub>2</sub> UPTAKE - (7/88 TO 12/89)

FUNDING SOURCE - EPRI

Studied the use of algae to remove carbon dioxide from fossil fuel exhaust gases. Hoped to develop ways to optimize algal CO<sub>2</sub> uptake.

\* POLYCULTURE EXPERIMENT - (11/88 to 12/90)

FUNDING SOURCE - Sea Farms of Hawaii

Demonstration of patent concept for a tank farm design. Allows for harvesting of multiple level tanks to increase production density.

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## **Past Research Projects at Keahole Point**

**\* MICROALGAE TESTING - (05/90 to 12/90)**

FUNDING SOURCE - Microbio Resources

Tested the growth of proprietary strains of *Dunaliella* and *Haematococcus*, microalgae. Gathered productivity data for these strains under the light and temperature regimes at NELH.

**\* FREON RECYCLING - (01/90 to 05/93)**

FUNDING SOURCE - Thermal Recovery Systems, Ltd.

Developed system to recycle used freon from air conditioners by cold seawater assisted solar distillation.

**\* NAMAKO (SEA CUCUMBER) CULTURE - (01/86 to 12/92)**

FUNDING SOURCE - D.S. Ventures, Ltd.

Investigated culture of sea cucumbers, a Chinese delicacy.

## **Past Research Projects at Puna Research Center**

**\* BOTTOM HEATING SYSTEM - (04/86 to 04/88)**

FUNDING SOURCE - DOE, Private Donations

Seed propagation and plant growth were significantly accelerated with soil warmed by geothermal waste heat. Commercial potential appears high.

**\* GREEN PAPAYA POWDER DRYING - (04/86 to 10/88)**

FUNDING SOURCE - DOE, Private Donations

Experimental dryer worked well with all types of fruits. The cost savings achieved using geothermal waste heat make the commercial potential high.

**\* LUMBER DRYING - (04/86 to 01/88)**

FUNDING SOURCE - DOE, Private Donations

Developed methods and drying schedules for local hardwoods. Drying was possible within 4 to 5 weeks.

**\* CLOTH DYEING BY GEOTHERMAL STEAM - (04/86 to 11/87)**

FUNDING SOURCE - DOE, Private Donations

Utilized flashed brine to dye silks and experimented with local dye sources. Hawaiian steam produces brilliant colors and sets dyes fast in Japanese silk.

**\* HAWAIIAN GLASS MAKING - (04/86 to 10/87)**

FUNDING SOURCE - DOE, Private Donations

Made glass from the silica by-product of the HGP-A well. Formula developed produced excellent art glass and was distributed to UHM and artists statewide.



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## Past Research Projects at Puna Research Center

**\* ATMOSPHERIC CORROSION - (12/86 to 4/87)**

**FUNDING SOURCE - UHM**

Quantified the corrosiveness of the geothermal environment to allow for better materials selection. HGP-A corrosion is uniquely determined by physicochemical conditions of the environment at the site. The corrosion rate is accelerated by the presence of hydrogen sulfide, chloride and sulfate ions at site.

**\* MEDIA STEAM STERILIZATION AND DRYING - (03/88 to 12/89)**

**FUNDING SOURCE - DOE, Private Donations**

Utilized the brine/steam to produce a sterile growing medium for plant growth. A pasteurized potting mix comprised mostly of lava cinder and shredded coconut husks would be used as an alternative to imported sterile soil from mainland.

**\* ELECTRODEPOSITION OF MINERALS - (03/88 to 12/89)**

**FUNDING SOURCE - DOE, Private Donations**

Researched the use of liquid brine samples to produce mineral deposits via electrolysis. Significant traces of calcium were deposited on test specimens by this method.

**\* SILICA BRONZE CASTING - (03/88 to 07/89)**

**FUNDING SOURCE - DOE, Private Donations**

Research developed techniques to separate, dry and wash silica from geothermal brine for use as a refractory material in bronze casting.

**\* DOWNHOLE COAXIAL HEAT EXCHANGER - (11/90 to 6/91)**

**FUNDING SOURCE - PICHTR, Private Donations**

Investigated the commercial viability of the DCHE technology, which provides a method of transferring heat from the well to the surface by circulating fluid in a closed system. After seven days of continuous operation, the temperature of the outlet water stabilized at 13.5 degrees Celsius above the inlet water temperature. These data agreed with the theoretical design predictions.

**\* SCIENTIFIC OBSERVATION HOLES - (05/90 - 4/94)**

**FUNDING SOURCE - HNEI**

Used the Puna Research Center facilities for storage, cutting and archiving of the core samples recovered in the SOH drilling program.

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**Craven, J.P.**, Mar 8-11, 1994, Coldwater agriculture as a component of a deep ocean water recovery system , *Conference Proceedings: Oceanology International '94*, Brighton, U.K., Vol 5, No. 17, 9p.

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**Fast, Arlo W. and Karen Y. Tanoue**, November 1988, eds., *OTEC Aquaculture in Hawaii*, UNIH-SEAGRANT-MR-89-01, UH Seagrant College Program, Honolulu, 178p.

**Fields, D.M. and J. Yen**, Gyrotaxis: Implications of Copepod Feeding Currents on the Spatial Orientation of their Prey , *J. Plankt. Res.*, In Press.

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## NELHA EMPLOYEES

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## NELHA EMPLOYEES [July 1994- June 1995]

**Robert K.U. Kihune**  
Executive Director

**Anderson, Stanley (Miles)** Laboratory Supervisor  
**Bean, Christine** Administrative Assistant  
**Brown, Donna** Account Clerk III  
**D'Amico, Michael** Security/ Utility Worker  
**Daniel, Thomas** Scientific/Technical Program Manager  
**Deverse, Kimber** Chemist III  
**Dunse, Monica** Microbiologist III  
**Espinueva, Georgette** Clerk Typist II  
**Galt, Ernest** Maintenance Mechanic II  
**Greenlees, Adrienne** Public Information Specialist II  
**Haleamau, Karin** Groundskeeper II  
**Hetherington, Gisela** Chemist III  
**Hua, Henry** Electrician II  
**Kaniho, Sheryll** Accountant V  
**Kelekolio, Melanie** Laboratory Assistant III  
**Kochy, Robert** Maintenance Mechanic II (Puna)  
**Kolman, Alan** Utility Electrician  
**Low, Harvey** Maintenance Helper  
**Manago, Dawn** Secretary IV  
**Matsumura, Tyson** Security/Utility Worker  
**McKee, Rosalinda** Groundskeeper II  
**McQuigg, Presley** Water Systems Foreman  
**Mirikitani, Eleanor** Administration Manager  
**Mitchell, Anthony** Maintenance Mechanic I  
**Oshiro, Scott** Engineering Project Coordinator  
**Pai, George** General Laborer  
**Pierce, Eugene** Electrician II  
**Placek, James (Buddy)** Electrical Engineer  
**Randall, Marion (Steve)** Security/Utility Worker  
**Vail, Mark** Vehicle/ Construction Equipment Mechanic I  
**War, Jan** Operations Manager  
**Weber, Jan** Clerk IV  
**Wohlfeil, Herman** Microbiologist IV



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NELHA

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