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Volume 2, Number 10 (October 1978)

The OTEC Liaison

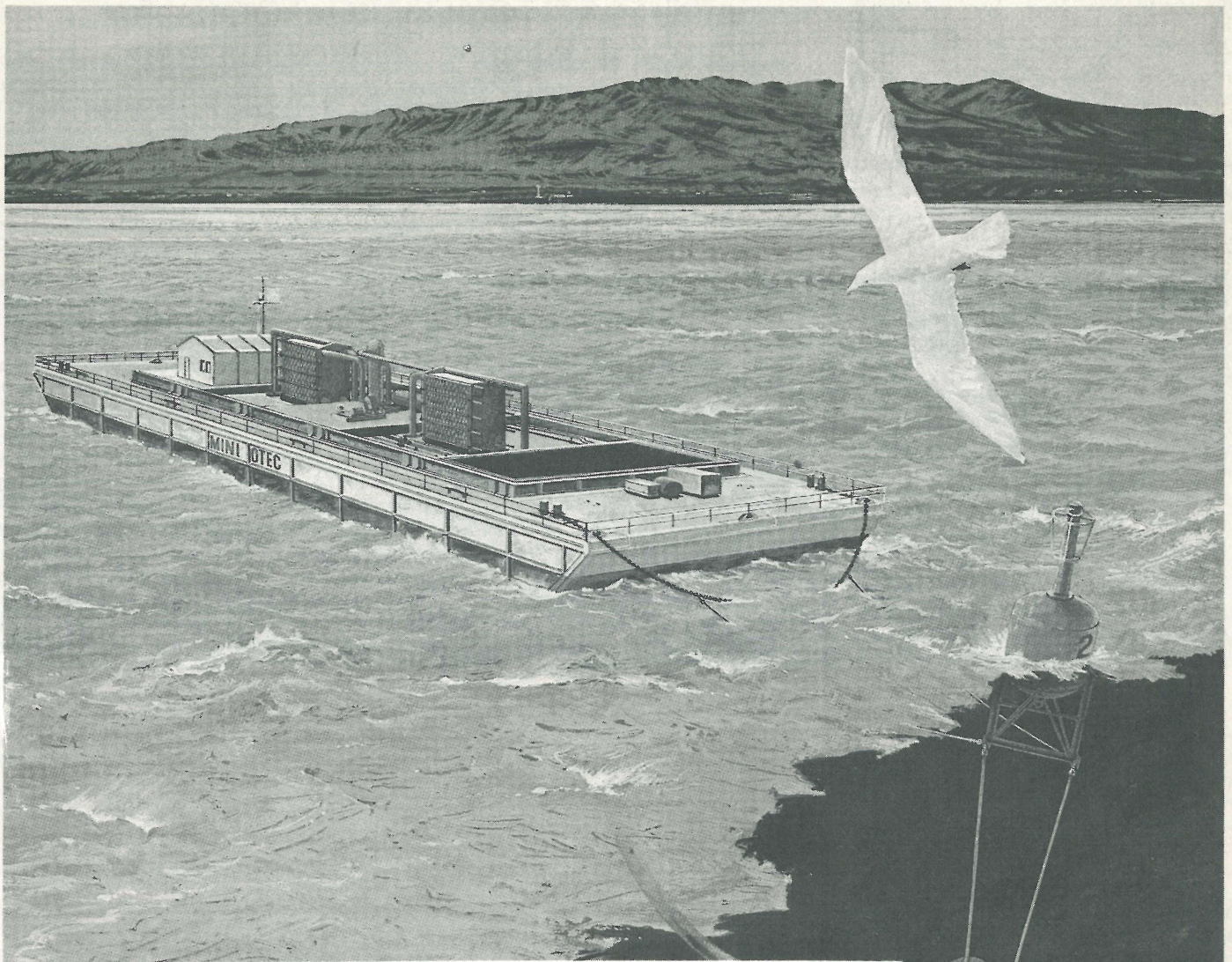
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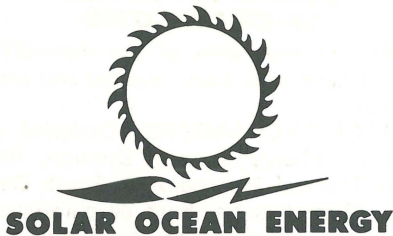
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The OTEC Liaison

VOLUME 2, NUMBER 10
October 1978

MINI-OTEC



The OTEC Liaison

AN INTERNATIONAL NEWSLETTER
ENGAGED AS LIAISON FOR THE
COMMUNITY OF OCEAN THERMAL
ENERGY CONVERSION

VOLUME 2, NUMBER 10
October 1978

EDITOR/PUBLISHER
Richard Arlen Meyer

TYPESETTER
AND COPY EDITOR
Shelly Treshansky

ART DIRECTOR
Pamela Greenfield

BUSINESS MANAGER
Robert Bernstein

CIRCULATION MANAGER
Denise Apter

SUBSCRIPTION MANAGER
Kathleen Guido

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FORTHCOMING OTEC ARTICLE

An article on alternative energy sources, with SOE/OTEC featured, will appear in a forthcoming issue of *Current Energy and Ecology* magazine, authored by Isabel S. Abrams, Science Editor.

Letter From The Publisher

Mini-OTEC... A Significant Milestone That Is Not "Mini" By Any Means...

It almost had to be called "mini"... to let the world know that it was only a miniaturized version of what those involved over the years in SOE/OTEC's development know will come in the future. But the significance of the important step of an operating OTEC plant, small as it might be, producing net electricity in the ocean will prove to be of major import next spring.

Not only will the Hawaiian test plant provide a basis for a great step forward in the learning process, but it will be a demonstration to the "doubting Thomases" that OTEC works. Ironically—and somehow justly—Mini-OTEC will be in operation almost exactly 50 years after Claude did his pioneering work off the coast of Cuba with his crude but significant power plant: a worthy anniversary that should be appropriately noted.

No Longer An "Exotic" Alternative Energy Source

This editor was recently explaining his activities in publishing TOL to the intelligent, aware, and imaginative chief executive officer of a renowned international accounting firm. Following an explanation of how OTEC works, the executive said: "Electricity out of sea water? You've got to be kidding!"

Even those more aware of OTEC's progress in recent years often have a similar attitude. A man who has worked for years with OTEC, in the US Department of Energy's Solar Division, told me recently in Washington that the disbelief often prevalent at the higher levels of DOE and in Congress and the Administration seemed to him to be representative of a feeling that "OTEC is almost too good to be true", based largely on the belief that "they seem to feel that you can't get something for nothing", and therefore OTEC can't possibly work.

Up until now there have been reams of paper studies and references to 100-year-old principles and 50-year-old crude experiments—and an almost unbelievable zealotry, enthusiasm, and dedication on the part of hundreds of men and women who have unshakable confidence in OTEC's potential and eventual successful implementation.

But no proof. No demonstrations. No hard-core visible evidence that the sun's energy can be extracted from sea water economically and without harming the environment.

Mini-OTEC will receive international publicity in 1979, demonstrating once and for all what many of us have known for years.

At the Sixth Annual OTEC Conference in Washington next June, we will have good reason to celebrate!

Cordially, Richard Arlen Meyer, Editor and Publisher

IMPORTANT CONFERENCE FOR OTEC ADVOCATES IN HOUSTON NOVEMBER 5TH THROUGH 9TH

TOL learned only recently of an important conference coming up shortly that all OTECers should take note of and possibly attend.

It is the **Energy Technology Conference and Exhibition** to be held in Houston's Albert Thomas Convention Center November 5th through 9th, sponsored by the American Society of Mechanical Engineers. (For more complete details see the *International Calendar* elsewhere in this issue.)

A major portion of the Conference will deal with OTEC, with papers being presented Wednesday morning, November 8th and panel discussion that afternoon.

Dr. Robert Cohen of DOE will present a major paper providing an overview of OTEC today. This editor has seen this paper and finds it extremely thorough and its conclusions carefully drawn. Papers will also be given by Horowitz of Argonne National Laboratories on OTEC Power Systems, Westinghouse on Capital Cost System Optimization for OTEC Power Modules, Bill Sherwood of DOE on Advances in

Ocean Engineering Aspects of OTEC, and Simplex Cable on Power Cables.

Dr. Neil Monney of the Department of Commerce will chair the afternoon panel session, titled *Status and Prospects of OTEC*. Panel members will include Fred Naef of Lockheed, Eugene Barseness of Westinghouse, Bob Scott of Gibbs and Cox, Nedret Basar of Rosenblatt, Bob Douglass of TRW, and Ben Silverstien of the Office of Technology Assessment. Also probably Bill Avery of APL.

Dr. Monney told TOL in mid-October that as many as 10,000 persons are expected at this major conference. Almost 5,000 attended last year. Monney said that "Anybody that's interested in OTEC ought to be there", adding that he plans to give each of the participants five or six minutes to run down the status of their involvement and what they see as the prospects, and then throw the meeting open to questions. He anticipated that there would probably be "some pretty hard questions".

ON HAWAII'S "MINI-OTEC": THE FIRST DEMONSTRATION OF SOLAR OCEAN ENERGY/OTEC IN THE SEA NEXT SPRING!

HAWAII, LOCKHEED, DILLINGHAM ANNOUNCE THEY WILL BUILD
AND OPERATE OCEAN-FUELED ENERGY PILOT PLANT

Honolulu, Hawaii: An electric-power generator floating on the Pacific Ocean and using warm surface water heated by solar radiation for fuel will begin test operations in the spring. It will be the first at-sea closed-cycle ocean thermal-energy conversion (OTEC) plant that will generate usable amounts of power.

The project, which involves the State of Hawaii; Lockheed Missiles and Space Company of Sunnyvale, California; and Dillingham Corporation of Honolulu, will begin assembling the generating plant immediately, according to Hawaii Governor George R. Ariyoshi, who announced the project September 28th.

The demonstration plant, referred to as a mini-OTEC, will be a scaled-down version of proposed huge sea-based generating plants. Ariyoshi said the 50-kilowatt plant will demonstrate that OTEC technology is feasible. When scaled up, a 100-megawatt plant could provide for the electrical needs of a city of 100,000 persons.

Hawaii and the other participants announced in April that tentative agreement had been reached to begin preliminary engineering design of such a plant.

Lockheed's program manager for mini-OTEC, Delbert N. Burwell, said the small plant would prove the feasibility of OTEC as a non-polluting electrical-power source. It could be an important milestone in Hawaii's search for energy independence and a key step in the national program to reduce dependence on foreign petroleum suppliers.

Burwell said the barge-mounted mini-OTEC plant will provide about 10 kilowatts of electric power above that needed for pumps and other operating equipment aboard. This net surplus power will be used to power test equipment on the barge. No electricity will be piped ashore.

The State of Hawaii will fund the half-mile-long pipe, which will carry cold water from the depths to the surface OTEC plant, and will also fund modification of a barge to be used as the OTEC plant machinery platform.

Lockheed will both design and build the OTEC power plant, which will operate with a closed-loop ammonia cycle.

Dillingham will modify and outfit the barge, assemble the system, and deploy the cold-water pipe and barge to the operating site, about one mile off Keahole Point, adjacent to the island of Hawaii.

Alfa-Laval to Contribute Heat Exchangers

A major contributor to the project is Alfa-Laval of Sweden, acting through the Energy Systems Division of Alfa-Laval Thermal Incorporated, South Deerfield, Massachusetts, one of its US-based operations. Alfa-Laval is furnishing two titanium heat exchangers, major components of the mini-OTEC power plant. The principal component sub-contractor to Lockheed is Rotoflow Corporation, Los Angeles, which is supplying the turbine-generator.

Dillingham, headquartered in Hawaii, is a diversified company active in maritime, resources, construction, and property. The company has been studying OTEC since 1975, concentrating on the construction and deployment aspects of OTEC plants. Lloyd Jones is manager of energy products.

Lockheed Missiles and Space Company, a subsidiary of Lockheed Corporation, has been involved in ocean-systems activities for more than two decades, beginning with development of the Navy's submarine-launched Fleet Ballistic Missiles (the Polaris, the Poseidon, and now, still in development, the Trident). Lockheed recently announced another project involving three other companies, two Dutch and one American, to develop technology to mine mineral-bearing manganese nodules, found in abundance on the deep-ocean floor.

DETAILS OF PLANNED 50-KW MINI-OTEC

Major components of the mini-OTEC system have now been selected and are as follows:

HEAT EXCHANGERS: Designed and built by Energy Systems Division, Alfa-Laval Thermal Incorporated, South Deerfield, Massachusetts, both evaporator and condenser are titanium, plate-type heat exchangers. The capacities of the heat exchangers are capable of being easily increased simply by adding more titanium plates.

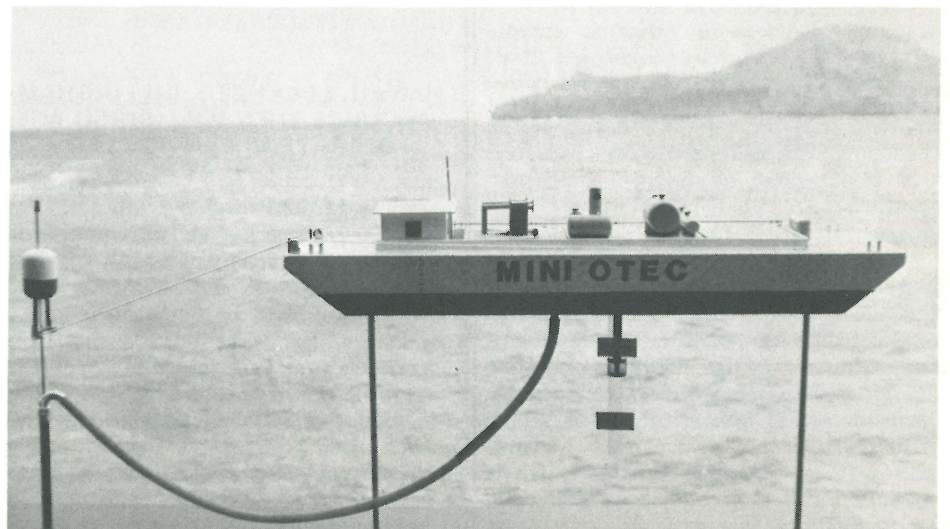
TURBINE GENERATOR: Designed and built by Rotoflow Corporation, Los Angeles, the turbine-generator will be rated at 65 KW input with an ammonia flow rate of five pounds per second. Electrical output is 50 KW (e), three-phase 115-208V.

SEAWATER PUMPS: The axial-flow pumps of 20 horsepower each will deliver 3300 gpm of both warm and cold seawater. The pumps will be mounted amidships of the support platform. The cold-water pump will be connected to the cold-water pipe with a 100-foot, 18-inch-diameter transfer hose.

SEAWATER PIPING: The cold-water pipe will be 28-inch-diameter, 2700-foot-long polyethylene. The warm-water and seawater return pipes will be made of the same material, but of smaller diameter and shorter length. The buoyant cold-water pipe will be anchored approximately 300 feet above the ocean floor. The top of the pipe will be connected to a spar buoy, which in turn will be connected to the support platform with hawsers.

Lloyd Jones, Energy Projects manager for Dillingham, reported that preliminary engineering studies conducted by Makai Ocean Engineering Company, Kailua, Hawaii, had resolved all the questions regarding deployment and mooring of the cold-water pipe, one of the most difficult operations.

(continued on Page 4)



With the ocean off Hawaii as a backdrop, this photo of a model of the 50-kilowatt Ocean Thermal Energy Conversion (OTEC) pilot plant shows how the system will appear. The half-mile-long cold-water pipe and the flexible connection to the barge-platform are at left. Hanging from the center of the barge is the warm-water pipe.

DILLINGHAM CORPORATION ACTIVE IN SOE/OTEC SINCE 1975

The Dillingham Corporation has been actively involved in the development of ocean thermal-energy conversion (OTEC) since 1975 as part of the company's program of tailoring its unique capabilities and resources to the investigation of alternative energy sources for use in Hawaii.

Dillingham brings to the project nearly a century of activity in the Pacific Basin in four major areas: maritime, resources, construction, and property. The Honolulu-based company, listed on the New York Stock Exchange, has already developed the feasibility study for the mini-OTEC project and co-ordinated a number of design stages. Its maritime operations are ready to begin barge towing, providing supply and support transportation systems, and activating shipyard capabilities for barge modification and maintenance. Dillingham's construction arm will be busy with platform and deep-water pipe construction.

Hawaii's fragile ecosystem, a 98% dependency on fossil-fuel imports, a continuing need to attract an expanded economic base, and untapped geographic resources have by necessity made it a center for scientific research toward energy independence.

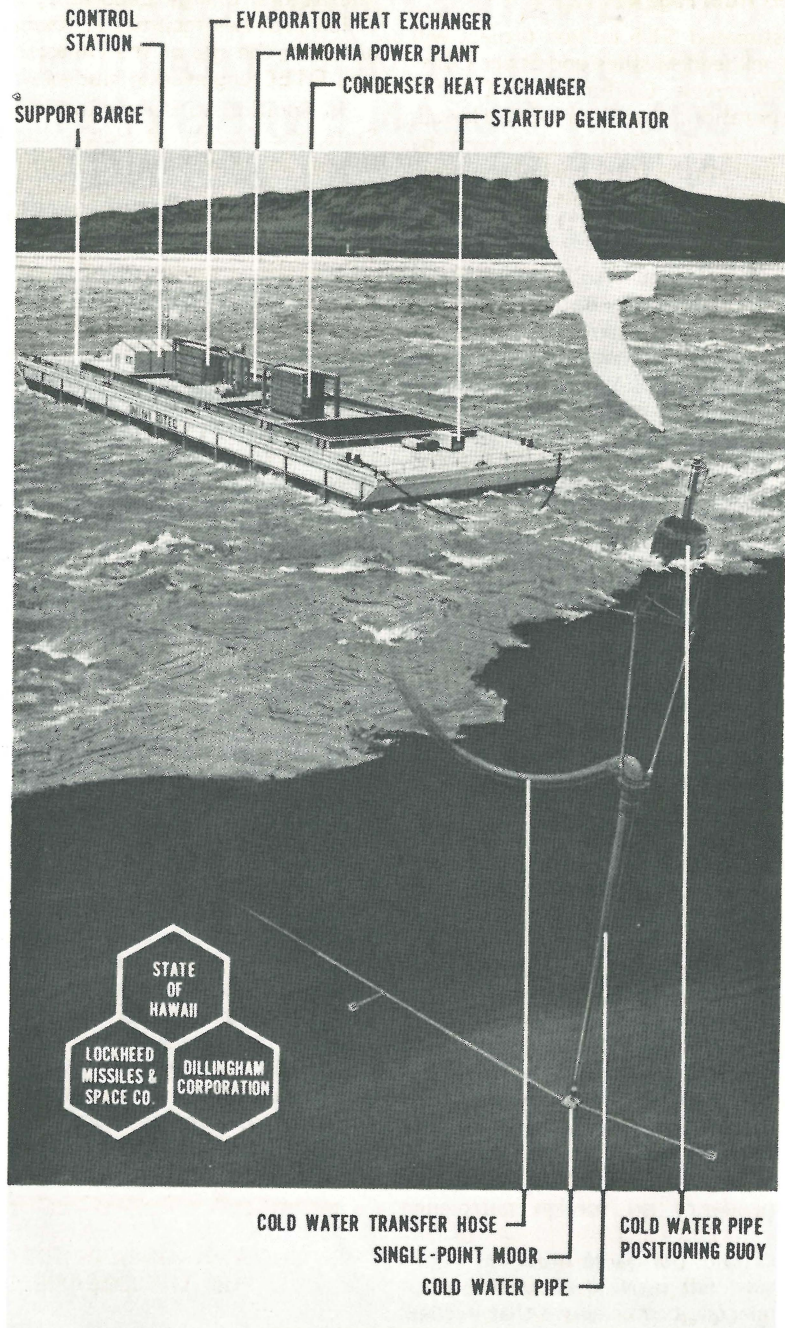
As a site for OTEC research, Hawaii provides close proximity to cold ocean depths and warm surface water, effective social and environmental impact monitoring, safe working conditions not subject to sudden violent storms, and an existing scientific and industrial community of worldwide reputation.

MINI-OTEC IS A PRIVATE ENTERPRISE

OTEC watchers and long-term OTEC advocates both should note that the Mini-OTEC project is a development of *private* initiative. It is the combined effort of the Hawaiian governments and private industry.

A Department of Energy spokesman recently referred to Mini-OTEC as "our" project, forgetting for the moment that it is entirely privately funded, without aid from DOE. While OTEC certainly would not be where it is today without the tremendous support of the US Government, it is noteworthy that the first operating OTEC plant is being undertaken entirely independently of federal funding.

Bureaucracies, as part of their inherent nature, move incredibly slowly—which is no secret. The fact that Mini-OTEC will be first in the water should therefore come as no surprise.



HAWAII, LOCKHEED, DILLINGHAM ANNOUNCE THEY WILL BUILD AND OPERATE OCEAN-FUELED ENERGY PILOT PLANT

(continued from Page 3)

Makai Engineering also conducted engineering studies and prepared designs of the barge modifications and outfitting.

Operations will be under the direction of Hank White, operations manager of the Hawaii Natural Energy Laboratory. "The importance of this project for providing a non-polluting alternate electrical-power source using a renewable fuel source cannot be over-emphasized," White stated. "Mini-OTEC will confirm the technical feasibility of exploiting the ocean thermal gradient and may play an important role in the energy economy of tropical islands in the foreseeable future."

THE STATE OF HAWAII'S NEWS RELEASE

(Below is information contained in the State of Hawaii's news release on "MINI-OTEC". While it duplicates to some extent information in this issue of TOL, it also includes some data not published elsewhere.)

**EXECUTIVE CHAMBERS
STATE CAPITOL
FRIDAY, SEPTEMBER 22ND, 1978**

Governor George Ariyoshi announced today that he has approved participation by the State in a project to construct and operate a demonstration 50-kilowatt Ocean Thermal Energy Conversion (OTEC) floating pilot plant off Keahole Point on the Island of Hawaii.

(continued on Page 5)

(continued from Page 4)

The estimated \$1.5 million project will involve Lockheed Missiles and Space Company of Sunnyvale, California; the Dillingham Corporation; the County of Hawaii; and the State. The State's share will be less than half of the total cost of the project. Lockheed will contribute \$760,000 in materials and services, and Dillingham will contribute \$112,000.

The project is called "mini-OTEC". It will demonstrate that usable amounts of electrical power can be generated using the sun's heat stored in warm surface ocean waters.

This newest announcement by Governor Ariyoshi follows a number of other recent major announcements of ocean- and energy-related projects:

- The State Administration announced September 8th the release of \$1 million in State funds for utilities and basic facilities at Keahole Point, where a major State science facility is to be developed.

- The US Department of Energy announced September 15th that the Global Marine Development Company has been awarded a \$42.7 million contract for an OTEC-1 project which would place a ship as a test platform 18 miles northwest of Keahole Point. It would be similar in principle to the mini-OTEC project, both being scaled steps looking toward a giant OTEC project.

- Governor Ariyoshi and Ocean Minerals Company announced September 15th that a new \$4 million test facility for manganese-nodule processing would be built at Oahu's Campbell Industrial Park.

The mini-OTEC project, essentially the same as OTEC-1 except on a smaller scale, is scheduled to generate power far ahead of OTEC-1, which is a much more elaborate project.

Governor Ariyoshi called the mini-OTEC project "another historic step toward Hawaii's long-term goal of becoming energy self-sufficient".

He said: "There is an enormous potential in Ocean Thermal Energy Conversion. We must proceed... step by step in the wise use of that resource. This Keahole project is a small step technologically, but critical to the anticipated success of giant generating plants of the future."

The power plant is expected to start operating next spring and continue for about six months until the desired test data are obtained.

Lockheed—which will design and build the power plant, the heart of the system—has studied OTEC engineering and economics since mid-1974. Dillingham will modify and outfit a barge loaned by the Navy, assemble the system, and deploy the cold-water pipe and barge to the site, about a mile off Keahole Point. The State will fund the half-mile-deep, 28-inch-diameter polyethylene pipe used to bring up the cold water, and modification of the barge as the plant machinery platform.

The Natural Energy Laboratory of Hawaii, which provides facilities at Keahole Point, has been the site of the University of Hawaii OTEC engineering studies since 1972.

In addition to private industry and the State, the County of Hawaii has been involved in organizing the project. State agencies involved include the University of Hawaii and its Hawaii Natural Energy Institute, the Marine Affairs Co-ordinator's Office, the Department of Land and Natural Resources, and the Department of Planning and Economic Development. The Research Corporation of the University of Hawaii, which administers the NELH, will manage the project.

The mini-OTEC system will use state-of-the-art and off-the-shelf components wherever possible. The purpose of the six-month test project is to gain extensive on-line operating experience and obtain "real world" data. These would be used to confirm continuing engineering studies aimed at the eventual development of OTEC systems generating hundreds of megawatts. (A megawatt is one million watts.)

Keahole is considered one of the world's ideal locations for such work because of the nearness to shore of very deep cold waters beneath tropical sun-warmed surface waters. The surface temperature remains steadily in the area of 75 to 82 degrees Fahrenheit, while the cold water is about 41 degrees Fahrenheit.

Although rated at only 50 kilowatts (50,000 watts), the mini-OTEC plant will contain all the essential elements of a full-scale OTEC plant. It is considered a forerunner of huge sea-based generating plants which could provide large amounts of electricity for commercial use before 1990. The mini-OTEC would generate 40,000 watts for operating the plant itself, and a surplus 10,000 watts for running tests and measuring equipment.



GROWING US DEPENDENCE ON THE OCEANS

Addressing a meeting of the National Advisory Committee on Oceans and Atmosphere (NACOA), MIT's Alfred A. H. Keil called for an integrated national ocean policy. He noted that in 1973 the oceans provided the US with over \$27 billion, measured in terms of gross product. By the year 2000, he told NACOA, the figure could be three or four times as much in 1973 dollars.

MAJOR OTEC ARTICLE SCHEDULED

Ocean Industry magazine has planned a major article on Solar Ocean Energy/OTEC for its November or December issue. The article will focus on the participation of major industrial and offshore oil firms in the OTEC program.

BUD FRANCIS TO SPEAK AT AIEE MEETING

The American Institute of Industrial Engineers (AIEE) has organized a joint Government-industry conference to be held in Washington DC October 30th through November 1st titled *Energy System Design/Procurement Conference* and subtitled *Design to Life Cycle Cost*. This newly-organized conference will cover (1) Department of Energy procurement policies, (2) case studies on current energy-system design, and (3) future energy policy and technology developments.

OTEC will receive special attention in a presentation by E. J. "Bud" Francis, Head of Planning and Economics for Ocean Thermal Energy Systems at the Johns Hopkins Applied Physics Laboratory.

Among the other featured speakers presenting policy announcements and case studies will be Clark W. Bullard, Director of DOE's Office of Conservation and Advanced Energy Systems Policy; Jackson Gouraud, DOE's Deputy Under-Secretary for Commercialization; William Babcock, Head of Economic and Policy Analysis for the Planning Research Corporation; and Dwight Bellinger, Manager of Performance Assurance for the Energy Systems Division of TRW Incorporated.

Further information can be obtained from AIEE Seminars, (312) 450-0500.

MARINE TECHNICAL SOCIETY FORMS OTEC COMMITTEE

Largely initiated as a result of exploratory meetings looking into the formation of an OTEC Council/Trade Association, the Marine Technical Society (MTS), based in Washington DC, has formed a permanent OTEC Committee, with Dr. Abraham Lavi as Chairman. Lavi told TOL in September that he plans to have the group established on two levels: an advisory panel and working groups. The latter would meet periodically—probably at least twice a year—with the advisory panel.

JAPANESE OCEAN POLICY STUDY UNDERWAY

Japanese ocean policy and how it is made is the subject of a two-year study to be carried out by the University of Southern California's Institute for Marine and Coastal Studies under a \$200,000 grant from the National Science Foundation. Investigators will examine the impact on Japan, and on future US-Japan relations, of the present "ocean-enclosure movement".

The OTEC Liaison requests readers to forward any and all photographs, sketches, or diagrams for publication. We wish to keep TOL lively and interesting, and we welcome contributions toward that end.

HAWAII TO GET FIRST OCEAN ENERGY PLANT

Will Be Set Up Off Big Island

by Harry Whitten
Star-Bulletin Writer

The nation's first floating test platform for extracting energy from warm ocean waters will be put in operation off Keahole Point, Kona, Hawaii by 1980, the Department of Energy announced today.

DOE said the Global Marine Development Company of Newport Beach, California had been selected to design, build, and operate the \$42.7 million project.

Global Marine, with subcontractor TRW Incorporated of Redondo Beach, California, was selected from four proposers, three of whom had planned to site their projects in Hawaii.

The announcement follows by a week the State's announcement of the release of \$1 million in State funds for basic development of Keahole as a major center for energy, aquaculture, and related scientific research.

In the meantime, negotiations are continuing between the State, Lockheed Aircraft Corporation, and Dillingham Corporation for a small 50-kilowatt facility at Keahole using the Ocean Thermal Energy Conversion (OTEC) technique.

The Department of Energy, in today's announcement, said it would fund \$25.4 million for the 18-month design and construction of the test platform. An additional \$17.3 million is expected to be required for the three-year testing phase.

Designated OTEC-1, an acronym standing for Ocean Thermal Energy Conversion Number 1, the test platform will be used to assess the potential of generating electricity from the temperature differences of the oceans.

In the concept, warm surface water would be pumped through heat exchangers to evaporate a working fluid, such as ammonia or Freon. The vapors would then spin a turbine to generate electricity.

After driving the turbine, the working fluid would be cooled by colder water drawn up from thousands of feet below until it becomes a liquid and begins the cycle again.

The test on board the OTEC-1 will concentrate at first on the thermal performance of the heat exchanger and on methods to inhibit and remove corrosion and the formation of biological slime, called "biofouling", on the water side of the sensitive heat-exchanger system.

Actual testing and evaluation of the heat exchangers and other components will be done by the Energy Technology Engineering Center, a division of Rockwell International.

Global Marine will convert a Govern-



Above is a reproduction of the front page of the September 15th issue of the Honolulu Star-Bulletin, announcing the Global Marine/TRW OTEC-1 project. (This is not to be confused with "MINI-OTEC", also recently announced in Hawaii, which is dealt with elsewhere in this issue.)

ment-owned T-2 tanker, the *Chepachet*, which is now in the Navy's mothball fleet, into the test platform.

The Hughes mining barge that had been used with the *Glomar Explorer* had originally been considered for the test platform, but Global Marine decided that the converted tanker would be safer, more stable, and a lower technical risk.

The Department of Energy took custody of the Hughes vessel in 1976, but no determination has been made of its final disposition.

Design and conversion of the tanker will take about 18 months, after which the company proposes to begin test operations at a site 18 miles northwest of Keahole Point.

Water there is 2300 feet deep and is roughly 35 to 40 degrees colder than at the surface—the temperature difference required to drive the OTEC system.

The company plans to pump the colder water to the surface using three 48-inch-diameter polyethylene pipes bound together and attached by a gimbal to the tanker.

The gimbal, a flexible connection like a universal joint, minimizes vessel motion caused by undersea forces acting on the almost-half-mile-long cold-water piping assembly.

This approach, DOE said, offers state-of-the-art development and poses little technical risk, making the overall proposal the most attractive combination of cost and technical considerations.

The testing program is expected to last at least three years, during which a variety of heat-exchanger concepts, ranging in size from 0.2 to 1 megawatt, will be tested.

CORRECTION AND ADDITION

(Due to an error in the September issue of TOL, the wrap-up of the major article on Japan's OTEC work was not included, and is therefore presented below.)

The report's conclusions include the following statements: **Remarkable results on the system characteristics and heat-transfer enhancement at the small-scale (test) facility have been obtained, and, finally, There is no doubt that OTEC power systems will have technical and economic feasibility in the near future.**

The complete 17-page report is available to readers from TOL on receipt of \$4 to cover copying, postage, and handling costs.

OFFSHORE OIL TECHNOLOGY LAYS PIPE AND GROUNDWORK FOR FUTURE OTEC POWER PLANTS

Our colleagues in the offshore oil industry are "paving the way" for future OTEC technology. The laying of a 47-mile 16-inch crude-oil pipeline in the North Sea will begin in 1979, with operation to begin in 1981 with a maximum flow rate of 96,000 barrels a day. Man's experience handling large objects over long distances in the oceans improves continuously, providing knowledge and experience that will be highly useful as the development of OTEC technology continues.

INTERNATIONAL CALENDAR

Listed below are conferences and symposiums pertinent to the OTEC community, ocean energy, and oceanographic technology. Major meetings recently completed are still listed for the benefit of any readers who wish to contact conference organizers for reports of proceedings.

Oct 9-12: 11th Annual Sea Grant Association Meeting and SGA Conference, Wentworth-by-the-Sea, Portsmouth NH. Theme: "Our Nation and the Sea: What's Ahead. Info: Christi Duerr, News and Information Services, University of Rhode Island, Kingston RI 02881; (401) 792-6271.

Oct 10-14: Symposium on Marine Geodesy and Ocean Dynamics, Miami FL. Info: Dr. George Maul, NOAA-AOML, 15 Rickenbacker Causeway, Miami FL 33149; (305) 361-5761.

Oct 19: American Oceanic Organization/National Energy Resources Organization Luncheon, Rayburn House Office Building, Washington DC. Reservations: AOO, (703) 522-0018.

● **Oct 23-25:** Short Course in the Preparation of Environmental Impact Statements, George Washington University, Washington DC. Info: Continuing Engineering Education, GWU, Washington DC 20052; (800) 424-9773 or (202) 676-6106.

Oct 23-26: Second Conference on Atmospheric and Oceanic Waves and Stability, Park Plaza Hotel, Boston MA. Info: William H. Hooke, Wave Propagation Laboratory, ERL/NOAA, Boulder CO 80302; (303) 499-1000, Extension 6378.

Oct 23-26: 12th Annual Conference of the Law of the Sea Institute, Hall of Knights, The Hague, The Netherlands. Theme: "Law of the Sea: Neglected Issues". Info: Scott Allen, Assistant Director, LSI, University of Hawaii, Honolulu HI 96822; (808) 948-6750.

Oct 24: MIT's Seventh Annual Sea Grant Lecture, Little Kresge Theatre, Massachusetts Institute of Technology, Cambridge MA. Info: E. R. Pariser, Associate Director, MIT Sea Grant Program, 77 Massachusetts Ave., Cambridge MA 02139; (617) 253-7135.

★ **Nov 5-9:** Energy Technology Conference and Exhibition, Albert Thomas Convention Center, Houston TX. Info: ETCE, PO Box 59489, Dallas TX 75229, or ASME 345 E. 47th St., New York NY 10017; (212) 644-8052.

Nov 6-10: Short Course in Dynamic Analysis of Offshore Structures, Boelter Hall, University of California at Los Angeles. Info: Julius S. Bendat, 10995 Le Conte Ave., Los Angeles CA 90024; (213) 476-6696.

Nov 7-9: Position Location and Navigation Symposium, San Diego CA. Info: Dr. Joseph Ravenis, Cubic Corporation, 9233 Balboa Avenue, San Diego CA 92123; (714) 277-6780, Extension 360.

★ Wednesday, November 8

SESSION 44

Room 107

9:00 A.M.

OCEAN THERMAL ENERGY CONVERSION (OTEC) (Ocean Engineering Division)

Chairman: O. M. GRIFFIN, Naval Research Laboratory, Washington, DC

Vice-Chairman: M. D. KELLEHER, Naval Postgraduate School, Monterey, CA

Session Developer: O. M. GRIFFIN, Naval Research Laboratory, Washington, DC

Some Early and Recent Novel OTEC Systems
O. M. GRIFFIN, Naval Research Laboratory, Washington, DC

An Overview of the U.S. OTEC Development Program
R. COHEN, U.S. Department of Energy, Washington, DC

OTEC Power Systems
J. S. HOROWITZ, Argonne National Laboratory, Argonne, IL

Capital Cost System Optimization of OTEC Power Modules
D. A. HORAZAK and T. J. RABAS, Westinghouse Electric Corporation, Lester, PA

Advances in Ocean Engineering Aspects of Ocean Thermal Energy Conversion
W. G. SHERWOOD, U.S. Department of Energy, Washington, DC, and W. P. TRZASKOMA, Gilbert Associates, Washington, DC

Power Cables to Accommodate the Motions of an OTEC Plant
C. A. PIERONI, D. O. LIBBY and R. T. TRAUT, Simplex Wire and Cable Co., Portsmouth, NH

SESSION 53

Room 107

2:30 P. M.

PANEL OCEAN THERMAL ENERGY CONVERSION: STATUS AND PROSPECTS (Ocean Engineering Division)

Chairman: N. MONNEY, U. S. Department of Commerce, Washington, DC

Vice-Chairman: R. COHEN, U.S. Department of Energy, Washington, DC

Session Developer: N. MONNEY, U. S. Department of Commerce, Washington, DC

Panelists:

B. ALEXANDER, Member of Congress, Washington, DC
F. NATH, Lockheed Corporation, Washington, DC
E. BARNES, Westinghouse Electric, Philadelphia, PA
R. J. SCOTT, Gibbs & Cox, Washington, DC
N. S. BASAR, Rosenblatt & Son, New York, NY
R. DOUGLAS, TRW, Redondo Beach, CA
B. SILVERSTEIN, Office of Technology Assessment, U.S. Congress Washington, DC

Nov 13-15: Workshop for State and Local Officials on the Onshore Impacts of Offshore Development, Charleston SC. Info: John Waxman, American Society of Planning Officials, 1313 E. 60th St., Chicago IL.

Dec 4-7: International Workshop to Evaluate the "Mussel Watch" Approach to Marine Pollution Monitoring, Barcelona, Spain. Info: Judy Graham or Barbara Jorgenson, National Academy of Sciences, 2101 Constitution Ave., Washington DC 20418; (202) 389-6511.

Dec 4-8: Second International Congress of the Environment, Palais des Congrès of Paris, France. Topics include the prevention of atmospheric pollution, chemicals in the environment, and pollution in the oceans. Info: Societe d'Expositions et de Promotions Industrielles et Commerciales, 40 rue du Colisee, 75381 Paris, France. Telephone 225-3776 or Telex SEPIC 640450F.

● **Dec 11-13:** Commercialization of Solar and Conservation Technologies Symposium and Workshop, Miami Beach FL. Sponsored by the School of Continuing Studies, University of Miami, Coral Gables FL. Info: Clean Energy Research Institute, School

of Engineering and Environmental Design, University of Miami, PO Box 248294, Coral Gables FL 33124.

● **Jan 16-18:** Academy Forum on the Development of Ocean Resources. Info: Judy Graham, National Academy of Sciences, 2101 Constitution Ave., Washington DC 20418; (202) 389-6511.

Feb 6-9: Asia Marine, Hyatt Singapore Hotel, Singapore. Info: Peter Johnson, Asia Marine, 6006 Bellaire Blvd., Suite 101, Houston TX 77081; (713) 666-5188.

● **Feb 26-28:** Sixth Energy Technology Conference and Expo '79, Sheraton Park Hotel, Washington DC. Papers should focus on "The Application of Technology to Satisfy the World's Energy Needs". Submit abstract and biography prior to 13 Sep 78 to Martin Heavner, Energy and Technology Conference, 4733 Bethesda Ave. NW, Washington DC 20014, (301) 656-1090.

Mar 12-16: Corrosion/79, Atlanta Hilton Hotel, Atlanta GA. Topics include Cathodic Protection (Marine), Marine Corrosion, and Protective Coatings. Info: National Association of Corrosion Engineers, Conference Co-ordinator, PO Box 986, Katy TX 77450, (713) 492-0535.

● **Apr 30-May 3:** Eleventh Offshore Technology Conference, Houston TX. Submit abstracts no later than 1 Sep 78 to Program Manager, Offshore Technology Conference, 6200 N. Central Expressway, Dallas TX 75206. Info: OTC Headquarters, above address, Telex 730989 SPE DAL.

US GOVERNMENT PROCUREMENT INVITATIONS AND CONTRACT AWARDS

Listed below are procurement invitations and contract awards related to OTEC in particular and ocean resources in general culled from the *Commerce Business Daily*. This is not to be construed, however, as a complete list.

Oct 3: Further Research on Remote Sensing of Sub-Surface Temperature and Salinity: Contract N00014-76-C-1007, 20 Sep 78 (no RFP), \$82,725, awarded to Computer Genetics Corporation, 18 Lakeside Office Park, Wakefield MA 01880.

Oct 3: Structural Analysis of Submerged and Floating Structures: Contract N00014-78-C-0719, 21 Sep 78 (no RFP), \$90,000, awarded to Weidinger Associates, 110 E. 59th St., New York NY 10022.

Oct 3: DOE Private Enterprise Technology Commercialization Process Model: Contract EM-78-C-02-4894.A001, for \$110,000, awarded to ORI Inc., 1400 Spring St., Silver Spring MD 20910.

Oct 3: 32 Tiros/Argos Oceanographic Drifting Buoys to Operate in a Moderate Sea Environment: Contract 03-78-G-03-0508, \$240,500, awarded to Popular Research Laboratory, 123 Santa Barbara St., Santa Barbara CA 93101. NOAA Data Buoy Office, National Space Technology Laboratories, NSTL Station, MS 39529.

● **Oct 4: Energy Supply Strategy: Getting Technology Commercialized:** Contract EJ-78-S-02-4973.A000, \$170,000, awarded to Rensselaer Polytechnic Institute, Troy NY 12181.

Oct 5: Energy Assessment Procedures Manual: Contract 68-03-2751, \$266,246 (RFP CI 78-0311), awarded to Hittman Associates Inc., 9190 Red Branch Road, Columbia MD 21045.

Oct 5: Program Support Services: Contract EM-78-C-03-2160, for \$29,711, awarded to The Aerospace Corporation, 2350 E. El Segundo Blvd., El Segundo CA 90245. US Department of Energy, 1333 Broadway, Oakland CA 94612.

● **Oct 6: National Energy Strategy (NES) Support Services:** RFP EJ-R01-6522 (62) will be available o/a 5 Oct 78. Requests should be in writing. No telephone requests will be honored. A pre-proposal conference is scheduled for 16 Oct 78.

Oct 6: Modified Acoustic Victor Averaging Current Meters for the Long-Term Measurements of Upper Ocean Variability: Negotiations are to be conducted with Neil Brown Instrument Systems Inc., 4 Robbins Rd., Falmouth MA 02540.

Oct 6: Further Research on Synthetic Aperture Radar Sensing of the Ocean Surface: Contract N00014-76-C-1048, 25 Sep 78 (no RFP), \$65,816, awarded to Environmental Research Institute of Michigan, PO Box 618, Ann Arbor MI 48107.

Oct 6: Structural Analysis of Submerged and Floating Structures: Contract N00014-78-C-0820, 25 Sep 78 (no RFP), \$70,000, awarded to Widlinger Associates, 110 E. 59th St., New York NY 10022.

Oct 6: Review and Analysis of Upper Ocean Models: Contract N00014-78-C-0849, 25 Sep 78 (no RFP), for \$98,933, awarded to Science Applications Inc., PO Box 2351, La Jolla CA 92037.

● **Oct 6: Integration Issues to Realize OTEC Market Potential:** Contract ET-78-C-02-5092, \$193,249, awarded to General Electric Co., Santa Barbara CA 93102.

Oct 6: Analysis to Determine the Requirements for the Ocean Survey Program: Contract N00014-78-C-0859, 26 Sep 78 (no RFP), \$64,715, awarded to Planning Systems Inc., 7900 Westpark Dr., Suite 507, McLean VA 22101.

Oct 6: Studies of Creep, Strain, and Tilt in the Southern California Area: Contract 14-08-0001-16718/Modification 3 (RFP 460W), \$40,027, awarded to the California Institute of Technology, Pasadena CA 91125. US Geological Survey, Building 13, Room 127, 345 Middlefield Rd., Menlo Park CA 94025.

● **Oct 6: Support Services to Field Studies and Pilot Plant Projects (RFP DU-77-A041):** Contract 68-02-2658, \$443,332, awarded to Southern Research Institute, 2000 Ninth Avenue South, Birmingham AL 35205; Contract 68-02-2686, for \$426,305, awarded to Battelle Memorial Institute, 505 King Ave., Columbus OH 43201; Contract 68-02-2687, \$417,448, awarded to GCA Technology Division of GCA Corporation, Burlington Rd., Bedford MA 01730; Contract 68-02-2688, \$450,973, awarded to Research Triangle Institute, PO Box 12194, Research Triangle Park NC 27709; Contract 68-02-2689, \$544,911, awarded to TRW Inc., One Space Park, Redondo Beach CA 90278. Environmental Protection Agency, Office of Administration, Research Triangle Park NC 27711.

Oct 6: Upgrade SAM/ASEPS File Format Configuration and Provide the Capability to Generate Environmental Acoustics Predictions in the Areas of the World's Oceans: Contract N66001-78-C-02903, 21 Aug 78 (N66001-78-R-0293), for \$98,774, awarded to Ocean Data Systems Inc., 6000 Executive Blvd., Rockville MD 20852.

Oct 6: Analysis of Data Acquired During the Mooring Dynamics Experiment Performed at Barking Sands, Hawaii: Contract 03-78-G03-0151, \$32825, awarded to Chi Associates Inc., Suite 316, 1011 Arlington Blvd., Arlington VA 22209. NOAA Data Buoy Office, National Space Technology Laboratories, NSTL Station, MS 39529.

● **Oct 10: Integration Issues to Realize the Market Potential of OTEC Energy in the Aluminum Industry:** Contract ET-78-C-02-5091.A000, \$303,369, awarded to Reynolds Metals Company, PO Box 1200, Sheffield AL 35660.

Oct 10: Environmental Assessment of Coal Waste Disposal in Ocean Waters: Contract EP-78-S-02-5029.A000, \$100,000, awarded to New York Energy Research and Development Authority, Agency Building Number 2, Empire State Plaza, Albany NY 12223.

● **Oct 10: Evaluation of DOE/SAN Appropriate Technology Pilot Program:** Contract EM-78-C-03-1855, for \$29,950, awarded to Booz-Allen Applied Research Division, 4330 East West Highway, Bethesda MD 20014.

Oct 11: Continuation of Solar Mini-Center Activities: Updating of SOLCOST Program and introduction of a Solar Index. Contract EG-77-C-02-4643.A001, for \$119,671, awarded to Solar Environmental Engineering Co. Inc., PO Box 1914, Fort Collins CO 80522.

Oct 11: Conceptual Design of U System to Support Assessment of Environmental Regulations on Energy Production: Contract EP-78-C-02-5004.A000, \$80,000, awarded to American Management Systems Inc., Arlington VA 22209.

Oct 12: Develop Demand Models for Energy Use in the Commercial Sector at the State Level: Negotiations are being conducted with Charles River Associates Inc., 200 Clarendon St., Boston MA 02116 for Contract EI-78-C-01-6313. B. Fredman.

● **Oct 12: Research and Technical Support Services for Assigned Tasks in Techno-Economic Studies:** Environmental assessments, state-of-the-art analyses, expert technical advice, and general staff assistance. RFP ET-78-R-01-3172. All requests must be in writing. No telephone requests will be honored. Department of Energy Office of Procurement Operations, Washington DC 20645. Attn: Document Control Specialist.

Oct 12: Non-Proliferation Alternative Systems Study: Contract EN-77-S-02-4571.A002, \$183,427, awarded to Massachusetts Institute of Technology, Cambridge MA 02139.

Oct 12: Wave Energy Resource Study: Contract ET-78-C-05-5697 (RFP ET-78-R-05-5697), 29 Sep 78, for \$57,348, awarded to the City University of New York and the Research Foundation of the City University of New York, jointly. Convent Ave. at 123rd St., New York NY 10031. US Department of Energy, PO Box E, Oak Ridge TN 37830.

● **Oct 12: Study of Influence of Emerging Technologies and Other Factors on the People and Management of the US Coast Guard:** Contract DOT - CG - 827240 - A (CG - 827240 - A), \$77,647, awarded to Forecasting International Ltd., 1001 North Highland St., Arlington VA 22210. US Coast Guard, Washington DC 20590.