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The Solar Ocean Energy Liaison

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JAMAICA: BIOFOULING TESTS NOW UNDER WAY

(Note: The following is the first in a series of articles on OTEC in Jamaica.)

The Petroleum Corporation of Jamaica (PCJ), in conjunction with Alfa-Laval Incorporated of Sweden, is now conducting biofouling tests on plate heat exchangers at Cow Bay Point, about 20 miles east of Kingston on the south coast of Jamaica. The tests began on October 19th, 1982, and are scheduled to last for 18 months in order to identify a possible correlation between biofouling and seasonal changes.

Within the test trailer (see photos) four Alfa–Laval plate heat exchangers are being tested, with different seawater flow rates through each heat exchanger. Two of the heat exchangers are made of titanium, and the others are made of stainless steel.

To determine biofouling resistance, fresh water is chilled and pumped through the heat exchangers in countercflow to the seawater taken from about one meter below the surface. Measurements are made of

(continued on Page 2)

Background information on Jamaica’s OTEC potential can be found in earlier issues of OE: July 1978, November 1979, and January 1982.

Jamaica has long been acknowledged as a prime OTEC site, not only because it is surrounded by abundant OTEC resources, but also because it is a prime source of bauxite ore, from which aluminum is produced. Moreover, the production of aluminum requires extraordinary quantities of electric power—4% of all (commercial, industrial, and residential) electricity in the US, in fact. At present, the bauxite mined in Jamaica is exported for processing elsewhere.

While the Jamaica Ministry of Mining and Energy has been observing OTEC’s progress for years, it has only been with the election of Prime Minister Seaga two years ago that the island’s tumultuous political problems have eased. This new political stability has encouraged recent development in Jamaica by foreign interests, including OTEC development.

The Petroleum Corporation of Jamaica and the Public Utilities Commission are currently evaluating several proposals for a commercial OTEC project to be commenced in the near future. This initiative, if carried through, will be a significant demonstration of the viability of OTEC for other developing nations which do not yet view OTEC as a near-term energy and freshwater alternative.

This series will explore the various activities now under way aimed at the implementation of commercial OTEC in Jamaica. There is a possibility that the final article in this series will include the official announcement of the world’s first private, commercial OTEC venture.

(continued on Page 3)
NOAA REORGANIZATION COMPLETED

The National Oceanic and Atmospheric Administration (NOAA) has finally consolidated its numerous ocean offices under a single heading in a reorganization effort that has been months in the making. The new National Ocean Service (NOS) is responsible for overseeing all ocean activities, and is headed by an Assistant Administrator. Currently acting in this role is Rear Admiral Kelly Taggart.

Dr. John V. Byrne remains the Administrator of NOAA.

Under NOS are the Office of Ocean and Coastal Resource Management (OCRM) and the Office of Oceanography and Marine Science (OMS). OCRM is responsible for overseeing all US ocean-resource activities, excepting fisheries but including OTEC. The former Office of Ocean Minerals and Energy (OME) is now the Division of Ocean Minerals and Energy of OCRM. The engineering functions of NOAA, formerly under the Ocean Technologies Office, now fall under OMS and include the Special Projects Office, which is concerned with, among other things, OTEC development.

Richard D. Norling will continue as the OTEC Program Manager at the OME, and Joe Vadus heads up the Special Projects Office.

This entire NOAA reorganization will hopefully result in a more efficient functioning of the agency and a more co-ordinated national oceans policy in the future than has existed in the past.

NOAA's FY 1983 budget for OTEC calls for an increase of $195,000 to a total of $723,000. This increase is necessary to enable the OME to do the research required to finalize the license-application process. The questions to be addressed with these funds will be the potential effects of OTEC operations on fisheries, and the downstream effects of plant discharges on other OTEC plants. The fisheries research will be conducted by NOAA's Marine Fisheries Service laboratories in Hawaii and North Carolina. The plume study funds will be transferred to DOE's Argonne National Laboratory.

(continued from Page 1)

inlet and outlet temperatures and flow rates for both seawater and test fluid, and from these the value of the overall heat-transfer coefficient (U) is determined. This value is compared with the original U value with the plates clean to determine the fouling resistance.

Counterfouling measures will include intermittent chlorination at different levels in three of the heat exchangers, and one of the titanium units is equipped with an Anodic Marine Protection System (AMPS), whose effectiveness will also be determined by the tests.

The information obtained from these tests will be used in the design of a one-megawatt OTEC plant planned for construction at the Cow Bay site.

In the January 1981 issue of OE, we reported on a rumored Navy PON bid for a geothermal-enhanced OTEC (GEOTEC) pilot plant at an Alaskan site. Now, two years later, the Navy's interest in GEOTEC has been confirmed.

GEOTEC is a concept which has certain advantages over "conventional" OTEC but has only recently been publicized (see the October 1982 issue of OE). The Naval Facilities Engineering Command, at China Lake, California, is actively pursuing the possibility of constructing a 12-megawatt GEOTEC facility at an unspecified Navy site, probably in Alaska. The announcement is detailed in the Government Procurements and Contract Awards section at the back of this issue.

We would like to extend special thanks to Lawrence Neuman of the UN's Ocean Economics and Technology Branch for providing us with a copy of the Guide to OTEC for Developing Countries (see the January 1983 issue of OE). We apologize for not acknowledging his assistance in our review of that publication.

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Solar OCEAN ENERGY Liaison Chicago 60605 February 1983 Page 3

(continued from Page 1)

The primary goal of the 1982-1983 GRI program is to establish kelp biomass yields. Kelp yields by subtle interactions of plant density, production of biomass by individual plants, and initial standing-crop biomass, as well as factors such as nutrient availability and water temperature. The three biomass-production projects being funded by the two-million-dollar GRI marine-biomass budget are contracted to General Electric (two projects) and the New York State Sea Grant Office as prime contractors.

Subcontracting to GE are Neushul Marine-culture Incorporated, a private R&D firm based in California, and the California State Polytechnic University (Cal-Tech). The State University of New York at Stony Brook is subcontractor to the New York Sea Grant Office in the marine-biomass program.

The Neushul project consists of two experimental half-acre plots at Goleta, California. Kelp plants were placed in an array of three different densities. One plot was fertilized, and the other was not. The results indicate that fertilization was particularly important in late summer, as the fertilized plot produced 50% more biomass than the unfertilized plot, but that during the rest of the year fertilization may not be required.

Four harvests have been conducted so far to assess the effect of density on biomass production. A range of 2 to 22 dry, ash-free tons per acre-year was produced by the kelp grown in different densities. Within each density configuration certain individual plants exhibited consistently superior growth rates compared with the average rate in each configuration. However density is significant to overall production and to the survival rate of kelp plants: The higher the density, the lower the plant survival rate. In addition, the plants in the higher-density configuration were smaller and had fewer fronds, or leafy branches, while the lower-density plants were larger and had more fronds. This suggests that kelp plants may regulate their own density to some extent.

Another observation of the past year was the discovery that a certain species of kelp is actually self-anchoring. This plant anchors itself in sand as its root-like holdfast penetrates the substrate and attaches itself to shell fragments and other buried debris. Lower substrate requirements significantly lower capital costs of the farm.

The discovery of the self-anchoring species, along with the findings that individual plants are significantly more productive and grow best in an optimized density configuration, has led the GRI to consider initiating a program of breeding plants which exhibit these desirable characteristics. This process of genetic selection should contribute to higher biomass yields and subsequently lower energy costs of this option.

The GE-managed Cal-Tech project involves the use of an enclosed hemi-dome structure (50 feet in diameter and depth) to regulate the nutrient levels and temperature of the growing environment. This facility, located in a cove at Catalina Island, California, is shown in Figure 1. In the first experiment at this site, high nutrient concentrations and higher temperatures resulted in an outbreak of a kelp infection known as shot-hole disease. Modifications of the feeding procedure and temperature of the water have resulted in an elimination of the disease problem. Further work will be conducted at this facility to evaluate yield results under various controlled conditions.

The New York State site and species study, co-funded by the GRI, the New York gas industry, and the New York State Energy Research and Development Authority, was initiated in 1980 to evaluate the marine-biomass-to-methane potential for the northeastern US. The first phase of this project involved the selection of three optimum species from nine candidate marine plants, performed in a controlled laboratory environment. The results of this phase have demonstrated the need for crop rotation, or multi-cropping of two species on a seasonal basis, due to the temperature sensitivity of the plants.

The second and current phase of the New York project involves field growth experiments with aquatic plants grown on small rafts. Lower yield rates on the rafts (as compared with greenhouse-optimized conditions) indicate that much needs to be learned about field cultivation procedures. Other aspects being investigated in this project include seedling techniques, fertilization needs, and the selection of genetically-superior strains.

In the area of biomass-to-methane conversion, the GRI and the Institute of Gas Technology (IGT) have developed an improved biomass digester which achieves significantly higher methane-production rates than conventional digesters. In the "up-flow solids digester", as it is called, the kelp is ground up into quarter-inch chunks and fed into the bottom of the unit. The digesting organisms settle on top of the mass of solids (that is, they are supported by the kelp), and excess water can be rapidly removed from the surface. This endows the digester with the desirable characteristics of a short hydraulic cycle and longer solids retention, as well as increased loading capabilities (over 20% more than conventional digesters).

Despite the higher loading, up to six standard cubic feet of methane are obtained from a pound of kelp. Digester performance (volume of methane produced per volume of digester per day) is three to three-and-a-half times better in the new unit than in conventional digesters. The implications of this development include lower capital costs for smaller digesters, lower nutrient requirements for microbial populations, and possibly greater stability in performance. Further development of digester technology is under way.

The GRI and the gas industry view methane from marine biomass as a long-range energy alternative. Other areas of related work include a net-energy-balance study, to be completed in March 1983, and international co-operative efforts. Currently, a distinguished aquaculture specialist, Dr. Xeng Fei of the People's Republic of China, is consulting on the GRI projects. The Japanese, who like the Chinese have considerable experience in cultivating kelp for food, are also eyeing the methane alternative. A team of Japanese scientists visited GRI sites in late January, and there are indications that some British and other European groups are also becoming interested in marine biomass for energy.

Methane is only one of the range of products available simultaneously from marine biomass, but it is the sole focus of GRI research. By co-ordinating the production of food, chemicals, and methane, significant cost reductions could be realized. GRI project manager Kimon Bird has suggested that a plant producing three million cubic feet of methane gas per day would realize a cost savings of $1.25 per cubic foot for every million dollars in by-products. Development and commercialization of this multi-purpose concept will require additional efforts to expand the

(continued on Page 4)

The inverted hemi-dome for growing marine biomass at Catalina Island.
market for the by-products in order to maintain those economies.

In general, the methane-from-biomass concept is technically feasible; but in the light of the current abundance of conventional natural-gas supplies (of geologic origin), it will probably not be commercialized until the first decade of the next century. Through continuing research, even under a loss sensitivity, the GRI is looking to solve problems posed by the critical research sensitivities through innovative approaches which will guarantee that fast-growing kelp strains and high-performance reactors are available for the gas industry’s use in the future.

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**ALTERNATIVE-ENERGY SEMINAR TO BE HELD IN SPANISH**

The Clean Energy Research Institute of the University of Miami is now organizing the Third International Seminar on Alternative Energy Sources—in Spanish—to be held in Miami, Florida May 9th through 15th. The course has been designed for a broad range of individuals concerned with applications of alternative energy sources in Spain, Central and South America, and the Caribbean. The program will be presented entirely in Spanish for the benefit of Spanish-speaking individuals interested in updating their knowledge in this rapidly growing field.

Presentations will include overviews of the most important alternative energy sources, including ocean energy. Special attention will be given to fundamental principles as well as applications to industrial, commercial, residential, and agricultural sectors. The first four days will be divided into morning sessions, in which basic concepts will be presented, and afternoon sessions, in which technical papers will be presented and discussed. The second three days will consist of trips to the Florida Solar Energy Center, the Kennedy Space Center, EPCOT, and the Magic Kingdom at Disney World in Orlando.

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**INTERNATIONAL RENEWABLE-ENERGY AND OCEAN-INDUSTRY FAIRS SLATED**

The Renewable Energy Institute and the US Export Council for Renewable Energy (ECRE), of which the Ocean Energy Council is a member, are co-sponsoring the Renewable Energy Technologies Symposium and International Exposition in Anaheim, California August 29th through September 1st, 1983. (See the May 1982 issue of OE for a full story on ECRE.) Unfortunately, this is concurrent with the MTS—IEEE-sponsored OCEANS ’83 Conference in San Francisco. The announcement of the meeting was received after press time, and therefore did not appear in our January calendar.

The Exposition has been awarded International Trade Fair status by the US Department of Commerce, and has also been endorsed by the US Department of State, the State of California, and the California Solar Industries Association.

As of press time, none of the industrial firms involved in renewable-ocean-energy development had reserved booth space at the exposition; so exposition organizers are now soliciting participation from the ocean-energy community. For more information contact TMAC, 680 Beach Street, Suite 428, San Francisco, California 94109.

In a related activity, TMAC is also organizing OCEANEXPO ’83 and OCEANTROPIQUES, which will be held concurrently in Bordeaux, France October 11th through 13th, 1983. OCEANEXPO ’83, the 5th International Oceanographics and Marine Technology Show, will feature exhibits by manufacturers and suppliers of offshore technology, services, and equipment. OCEANTROPIQUES is the 2nd World Show and Conference on the achievements, projects, and products of developing countries in the area of oceans, harbors, rivers, and lakes. The combined focus of the two shows will provide exhibits with a unique opportunity for communication and trade between industrialized and developing countries.

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**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.


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**Jan 20: Municipal Solid–Waste Energy–Conversion Feasibility Study on Guam and American Samoa: Solicitation DE–AC–03–83–SF–11897. Energy for the Pacific islands is almost entirely derived from imported petroleum; however available solid wastes contain high percentages of paper and cardboard which can be used as a fuel source for electricity generation. The Department of Energy, as part of the Pacific Energy Assessment, proposes to contract for a study to determine the feasibility of developing municipal solid–waste energy-recovery facilities in the Pacific, specifically on Guam and American Samoa, with resulting generic recommendations for other Pacific islands. Negotiations will be conducted on a sole-source basis with International Energy Enterprises Incorporated, New York, New York. US Department of Energy, San Francisco Operations Office, 1333 Broadway, Oakland, California 94612. Liaison Chicago 60605 February 1983.**