


3-1-1981

Volume 5, Number 3 (March 1981)

The Solar Ocean Energy Liaison

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NSUWorks Citation

The Solar Ocean Energy Liaison, "Volume 5, Number 3 (March 1981)" (1981). *The OTEC Liaison*. 43.
https://nsuworks.nova.edu/nsudigital_otec-liaison/43

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Solar OCEAN ENERGY Liaison

INCORPORATING
The OTEC Liaison

VOLUME 5 NUMBER 3
March 1981

OTEC-1 ACHIEVES SUCCESS IN EARLY TESTING

A mid-March interview with a spokesman for ETEC (the Energy Technology Engineering Center of Rockwell International), operators of OTEC-1 for the US Department of Energy, clearly conveys the series of successes for early stages of the OTEC test platform.

ETEC is responsible for the overall operations of OTEC-1, including the actual testing of elements of the system itself, such as the ammonia and water systems. Tracor Marine, as subcontractor to ETEC, supervises the ship's operations, including transporting personnel to and from the ship and providing supplies. ANL (Argonne National Laboratories) does the analyses of data from the heat exchangers and power system, reviewing initial analyses by ETEC. NOAA (the National Oceanic and Atmospheric Administration) reviews the ship's systems, the cold-water pipe, the moorings, and so on. Environmental concerns are supervised by the Lawrence Berkeley Laboratories of the University of California.

The ETEC/Tracor team took over re-

sponsibility for the operations of OTEC-1 from Global Marine—which converted the ship for OTEC testing—in early December, following acceptance testing.

At present, an evaporator and condenser unit designed and constructed by TRW (40 Mw thermal, 1 Mw electrical) is being tested. While the water system has been operating since mid-December, the first test involving ammonia and the heat exchangers was performed New Year's Eve, and these elements have been operating without interruption since that date, with "the system responding very well and with no major problems."

Concerns About the Cold-Water Pipe

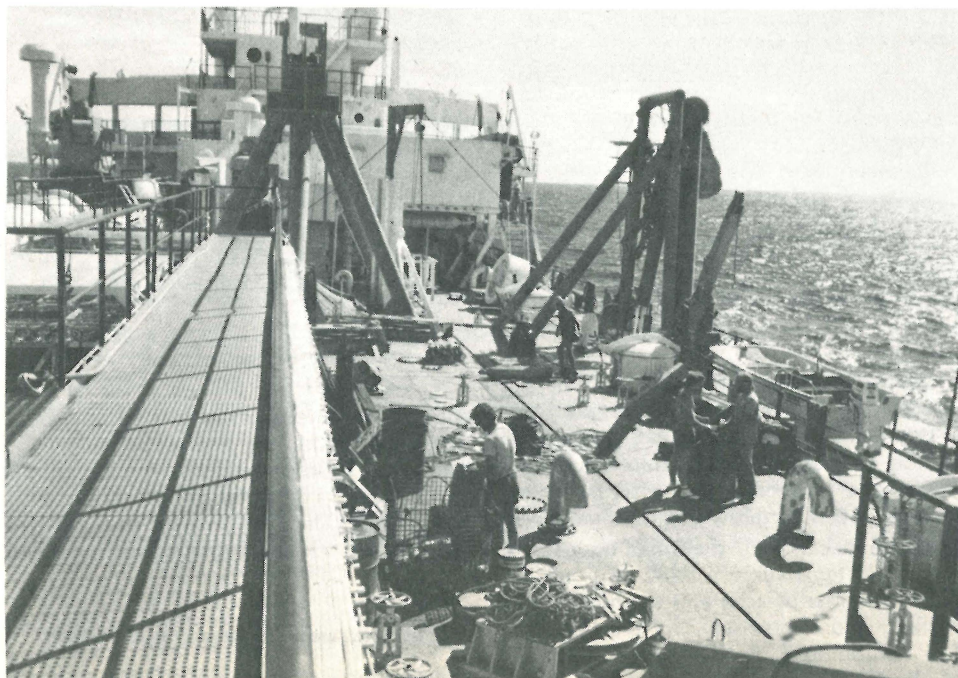
As recently as September 1980, concern was evidenced by DOE and NOAA regarding the viability of OTEC-1's cold-water pipe (CWP). Measurements of currents in the area off the coast of Hawaii were estimated to be much lower than later discovered, causing concern that the cold-water pipe would be threatened. Con-

tingency plans for either high currents or storm activity are to disconnect the CWP from the ship and lower it to escape turbulent sea conditions, to be later raised and reconnected. Lunar tides were also of concern. Any disconnection of the CWP would severely limit the usefulness of bio-fouling experiments, which require long-term consistency to prove worthwhile.

The likelihood of damage to the CWP is determined by the angle between the CWP and the ship, with 30° the limit; at 30° deflection, the CWP would hit a stop on the ship, with severe damage or break-off imminent.

Until early March the maximum deflection was about 14°. But a recent storm—with seas as high as 12 feet and winds gusting up to 45 knots—sent the deflection up to as high as 22°. However the ship's op-

(continued on Page 3)



A view aboard the deck of OTEC-1, also called S. S. Ocean Energy Converter, currently anchored 18 miles off the island of Hawaii. Three 48-inch pipes descend 2100 feet beneath the hull, bringing cold water to the OTEC components onboard for testing.

FINAL TALLY: NINE BIDS RECEIVED BY DOE FOR PILOT PLANT PON

As of February 27th, the closing date for acceptance of bids by the US Department of Energy for the PON (Program Opportunity Notice) for the OTEC Pilot Plant, a total of nine bids were received.

Six of these bids were listed as firm and were detailed as to site, concept, prime contractor, and the like in our January issue.

The other three bids, two of which were listed but unconfirmed in our January issue, are as follows:

SITE: Puerto Rico: Sea Solar Power is the prime contractor, with General Dynamics as systems integrator.

SITE: Hawaii: General Electric is the prime contractor, with Brown and Root as systems integrator.

SITE: Alaska/Aleutian Islands: The California Energy Corporation is the prime contractor, with Sea Solar Power as systems integrator.

No foreign bids were received. The potential bid from the State of Maryland/Bethlehem Steel (called "MOTEC", for Maryland OTEC Corporation) was not submitted. However MOTEC spokesmen indicate that they may pursue OTEC commercially through other avenues.

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AN INTERNATIONAL NEWSLETTER
ENGAGED AS LIAISON FOR ALL
FORMS OF SOLAR ENERGY FROM
THE SEA, INCLUDING:

OTEC
(OCEAN THERMAL
ENERGY CONVERSION)
WAVE - TIDAL - CURRENT
OFFSHORE WIND - BIOMASS
SALINITY GRADIENTS

VOLUME 5 NUMBER 3
March 1981

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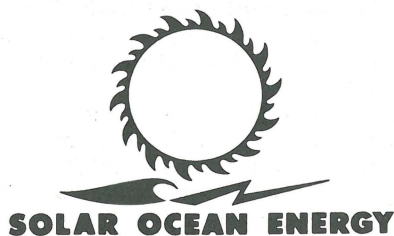
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THE FY 1982 DOE OTEC BUDGET

The detailed US Department of Energy (DOE) Budget Request for OTEC/Energy Systems for Fiscal Year 1982, which begins October 1st, 1981, is very much up for grabs as this issue goes to press, in late March.

The outgoing Carter Administration's request was for \$37 million—\$2 million less than the previous year. Yet the Reagan Administration's large-scale budget cuts did not overlook Ocean Systems (or other solar technologies), with the first round of cuts reducing the FY 1982 budget to \$27 million.

While not viewed with joy by the OTEC community, this was generally expected, bearing in mind Reagan's desire to cut federal spending, together with his lack of faith in renewable energy. However shock was felt throughout the OTEC field when, on March 10th, DOE reduced the budget for Ocean Energy Systems to zero. If the reduction stands, this would virtually wipe out the US OTEC program and throw the lead to the Japanese, who have *increased* their OTEC budget (see the September 1981 issue of OE).

While no hard information has been forthcoming, the general consensus is that it was DOE and not the OMB (Office of Management and Budget) that specifically reduced the FY 1982 OTEC budget request to zero. It has long been known that DOE has been pro-nuclear and has fought increased funding for other solar technologies and for Ocean Systems in particular.

In light of this, coupled with Reagan's known policy of relying on increasing oil and gas availability within the US to provide the "energy independence" he claims as his goal, the vast reductions come as no surprise.

But no one expected a *zero* recommendation. In fact, Governor Ariyoshi of Hawaii was assured by DOE's Secretary Edwards in late February of continued federal support for OTEC next year of about \$27 million.

Between now and the final action of Congress on the proposed FY 1982 budget, much will take place behind the scenes which will affect OTEC's funding. This will include Congressional hearings, lobbying, trade-offs within Congressional committees, pressures from public officials, and more.

With rumors running rampant, OE was informed late in March that a Senate committee had recommended that the full \$39 million be restored. But while this recent good news is encouraging after so much bad news, it is certainly not the final word.

OE expects that the final budget for Ocean Systems for FY 1982 will fall between the low of zero and the high of \$39 million. More precisely, in the range of \$15 million to \$23 million, with the bulk of the funding for continued operation of OTEC-1, which now costs about \$1 million per month for total operations. It is expected that both Phases I and II of the

Pilot Plant PON will also be funded, with announcement of awards not taking place before late fall of this year.

Further updates on the DOE OTEC budget will appear monthly in OE until finalization, which is expected before the end of June.

WESTINGHOUSE AND OTEC

For many months it has been rumored that Westinghouse is no longer involved in OTEC. Westinghouse was the "major OTEC contractor" which had tentatively dropped out (see the October 1980 issue of OE), but had asked not to be identified at that time. More specifically, Westinghouse's top management had decided not to be prime on the bids for the OTEC Pilot Plant PON.

Since then, however, Westinghouse has dismantled its OTEC team: Eugene Barsness and Brian Coffay, while continuing at Westinghouse, are no longer involved with OTEC, and Gene Barsness has regrettably resigned his Directorship of the Ocean Energy Council.

Open-Cycle Contract

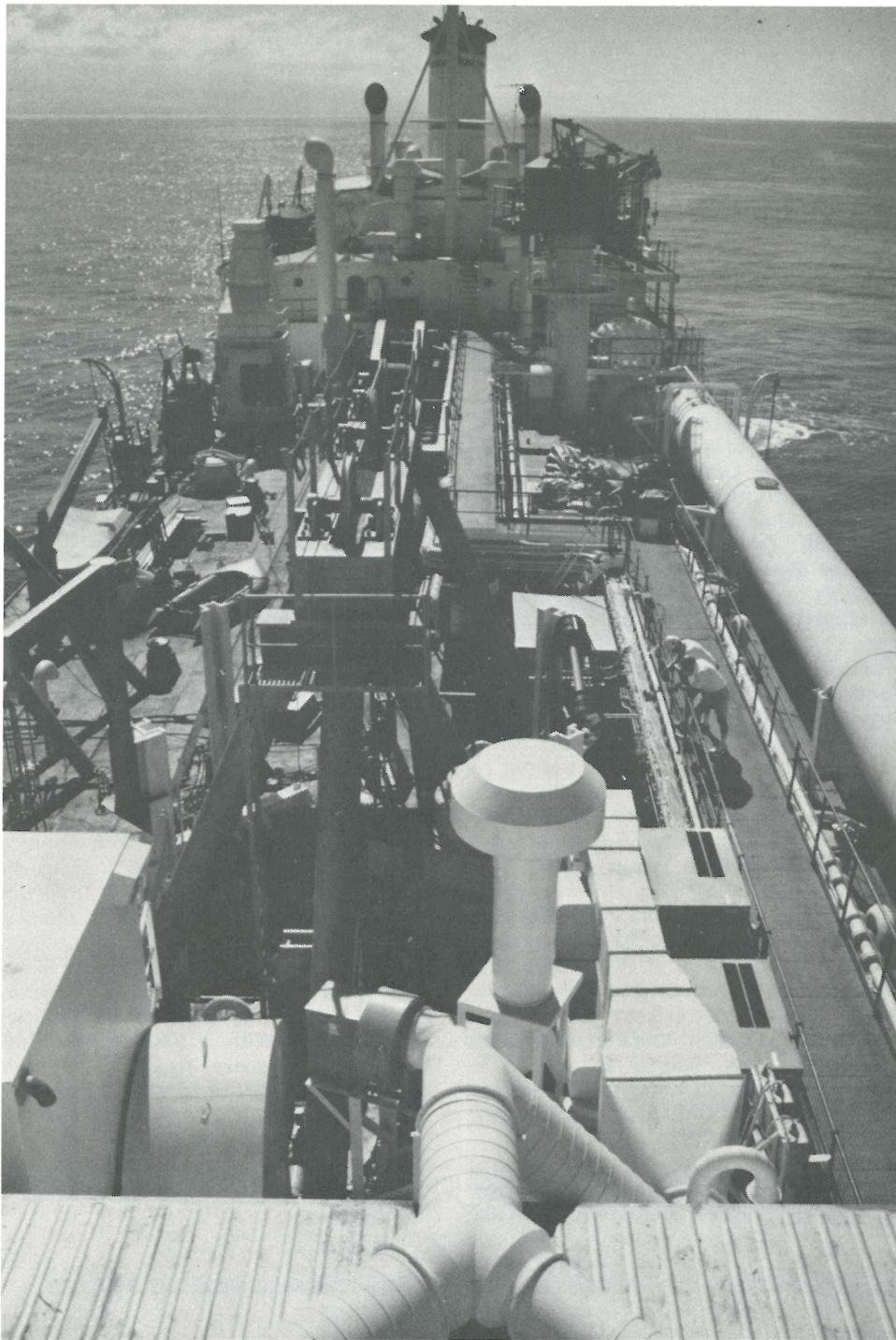
Despite its withdrawal from active participation in OTEC commercialization efforts, Westinghouse recently received a \$737,000 extension of a contract with the Solar Energy Research Institute (SERI)—a contractor to DOE—for further research on open-cycle OTEC. This will include flash-evaporator research (see story on the Virgin Islands in the December 1980 issue of OE) and studies of the huge turbine necessary for open-cycle operation.

The turbine will be almost 45 meters in diameter, operating at 200 rpm with blades almost 13 meters long fabricated of composite laminations of fiberglass and epoxy resin. The blade design was based on the technology used in designing helicopter blades, with the co-operation of the Vertol Aircraft Division of Boeing.

Further information may be obtained from Ben Shelpuk at SERI in Golden, Colorado, (303) 231-1000.

Alternative Directions in Energy and Economics Incorporated has produced an informative four-page fact sheet on OTEC to provide OTEC information to the general public. The fact sheet is available on request from ADEE, 777 Valencia, San Francisco, California 94110.

Patent Number 4,222,238 was recently issued for an "Apparatus for Obtaining Energy from Wave Motion".



Another view of OTEC-1 at sea off Hawaii.

OTEC-1 ACHIEVES SUCCESS IN EARLY TESTING

(continued from Page 1)

erators learned that they could maneuver the ship to minimize the effect of current and heavy seas on the CWP. The storm was so severe that transportation of men and supplies, normally undertaken daily, was not performed for five days. (A helicopter pad was originally included in the design of OTEC-1, but was later deleted as one of many economy measures. None of the cost-cutting measures, however, were seen by the ETEC spokesman as compromising the system itself.)

The mode of the testing at the time of this interview was one in which the configuration of the heat exchangers could be changed internally. This type of configuration would be equivalent to a 4 Mw electrical rather than a 1 Mw electrical, "which gives you a module for the pilot plant. What we're doing is, we're actually operating in the mode that feeds data to the pilot plant."

No Indication of Biofouling

After about 1600 hours of operation, there has been "no indication of biofoul-

ing" on either the cold-water or the warm-water side. Specialized biofouling modules are placed on deck to monitor any biofouling. Amertap balls are used regularly for cleaning, however, with one ball going through the system about every 15 minutes; but in the absence of any fouling, this was to be discontinued in mid-March to determine what effect, if any, the use of these cleaning balls had on biofouling.

In addition, chlorination is being used minimally. The chlorine being used is at or below the EPA (Environmental Protection Agency) limit for shore-based plants. That limit is two tenths of a part per million for two hours within a 24-hour period. Chlorination will also be reduced or eliminated in later testing to determine its effect on biofouling.

Aside from the main systems, smaller test modules without either chlorination or cleaning balls have been operating for several weeks, but not long enough to provide useful data. Longevity of these tests is an important factor in biofouling testing, as detailed in the February issue of OE regarding research in Puerto Rico.

[Editor's note: The Puerto Rico tests were performed in 3600 feet of water two miles offshore, while OTEC-1 is moored in 4,000 feet of water over eighteen miles offshore, with a CWP 2200 feet long. Some feel that the distance offshore directly affects biofouling.]

Cold-water temperatures are about 40° to 41°, and surface temperatures are between 78° and 80°, creating a 40° delta-T at about the coldest time of the year in Hawaiian waters. The ETEC spokesman noted that even a change in temperature of 1° or 2° is rapidly noticeable in the system, and that "the condenser is working better than we had predicted, and the evaporator is running as well as or better than we had expected."

Who Will Benefit from OTEC-1?

Since start-up operations of OTEC-1, several groups have had the opportunity to tour the facility, including a group from Japan. If the proposed OTEC budget cuts are implemented by DOE, virtually killing the US OTEC program, it appears that the Japanese may be the greatest beneficiaries of the knowledge gained from the OTEC-1 test platform.

A long-needed reference is now available in *The Ocean World Encyclopedia*, published by McGraw-Hill and co-authored by Donald G. Groves and Lee M. Hunt, both professional staff members of the National Research Council of the National Academy of Sciences. Don Groves is a long-time advocate of OTEC/ocean energy, a subject adequately covered in this new publication.

DEBATE CONTINUES ON OTEC, OCEAN HEAT, AND ATMOSPHERIC CO₂

About the only area left for those negative about OTEC to harp on, since all the other objections have been laid to rest, is the one that cannot be resolved: OTEC's possible effect on the world's climate.

With biofouling and cold-water-pipe concerns generally satisfied with ongoing tests aboard OTEC-1 (see story elsewhere in this issue), OTEC detractors may again raise the issue of OTEC's possible effect on ocean heat and atmospheric CO₂. Some feel, if you haven't already heard, that thousands of OTEC plants would upset the natural conditions of the Earth by withdrawing too much heat from the world's oceans. Another fear is that CO₂ now dissolved in the oceans would be released, thus upsetting natural balances.

Two researchers at the State University of New York have added to the already voluminous material on this subject—all speculative—by suggesting that absorption of heat by the oceans will delay CO₂-induced global warming by about two decades. In the January issue of *The Journal of Geophysical Research*, Robert D. Cess and Steven D. Goldenberg conclude that when oceans are considered as a heat sink, global temperatures can be expected to rise 1.5° to 1.8° by the year 2025.

Their paper did not include any mention of OTEC's possible influence. But then, there are many other researchers who are convinced that the Earth is not warming at all, but actually cooling off. (One just doesn't know what to believe.)

Possibly, after four or five hundred OTEC plants have been operating for some time, some trend may be noted. In the meantime, conjecture about all of this will continue to occupy some and continue to amuse us.

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.

Jan 30: Continuation of Technical Services in Aquaculture Technology Development Activities Under Contract AID/DSAN-C0053: Negotiations are being conducted with Auburn University, Auburn, Alabama 36830. US International Development Cooperation Agency, Agency for International Development, Office of Contract Management, Central Operations Division, Agriculture/Nutrition Branch, Room 744 SA-14, Washington DC 20523.

Jan 30: Technical Services in the Areas of Wave Modeling, Wave Statistics, and the Analysis of Measured Wave Data: Includes investigation of the fit of specific wave data to a Rayleigh distribution; modifications to the Navy's Spectral Ocean Wave Model computer program to account for resulting nonlinear phenomena; and a determination of the effect of these results on extreme value theory. Negotiations are being conducted with Professor Pierson of the University of New York. David Taylor Naval Ship R&D Center, Bethesda, Maryland 20084, Attn: N. Teasdale, (202) 227-3605.

Feb 3: Determine the Possibility of a Ship Encountering Some Kind of Extreme Waves: The objective of this project is to determine the possibility of a ship encountering some kind of extreme waves and to understand the significance of this in ship structural design. RFP DTG-23-81-R-20007. Contracting Office: Commandant (G-FCP-2/CGHQ64), US Coast Guard, Washington, DC 20593.

Feb 3: South Atlantic OCS Physical Oceanography Field Study, Year 4: Negotiations are being conducted only with Sci-

ence Applications Incorporated, La Jolla, California, since they have been performing the study effort during the three preceding years and have the background and expertise required to perform the study effort. US Department of the Interior, Bureau of Land Management, Code 851, 19th and C Streets Northwest, Room 2447, Washington DC 20240.

Feb 5: Further Pacific Oceanographic Studies: Contract N00014-80-C-0440, January 12th, 1981 (no RFP), \$521,226, awarded to the University of California, La Jolla, California 92093. Office of Naval Research, 800 North Quincy Street, Arlington, Virginia 22217.

Feb 5: Establishment of a National Community Energy Center: Contract FC-02-81-CS-24457 (unsolicited proposal), for \$1,575,077, awarded to the Academy for Contemporary Problems, 1051 Neil Avenue, Columbus, Ohio 43201. Department of Energy, Office of Procurement Operations, Washington DC 20585.

● **Feb 9: An Ocean Thermal Energy Conversion Environmental Impact Statement:** Contract NA-81-RA-C00015, \$147,930, awarded to Interstate Electronics Corporation, 1001 East Ball Road, PO Box 3117, Anaheim, California 92803. Procurement Office, National Oceanic and Atmospheric Administration, Boulder, Colorado 80303.

Feb 23: Studies on Technical Issues in Ocean and Atmospheric Sciences: Negotiations are being conducted with Planning Systems Incorporated, 7900 Westpark Drive, McLean, Virginia 22102. Office of Naval Research, 800 North Quincy, Arlington, Virginia 22217.

Mar 3: Technical Analysis and Evaluation of Relationships Between Environmental and Energy Development Policies and Programs With a View Toward Improving the Balance Among Economic, Environmental, Energy, Health and Safety, Social, and Regulatory Factors. Solicitation RP-01-81-EV-10472. US Department of Energy, Attn: Document Control Specialist, PO Box 2500, Washington DC 20013.

WE'RE NOT ALONE: OUR COLLEAGUES IN BRITAIN ALSO FEEL NEGLECTED!

Advocates of renewable energy in Britain feel that the Central Electricity Generating Board (CEGB), Britain's publicly-owned utility, is neglecting R&D in its

field. The United Kingdom now spends about \$26.9 million annually on wind, wave, geothermal, and tidal energy research.

In a recent interview, CEGB Planning Director John K. Wright said that while until recently the CEGB "had set great

store in wave power", it is "becoming clear that harnessing wave power in the near future is difficult and expensive".

Regarding direct solar electricity generation, Wright said: "We are one of the last places in the world for that application."