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The OTEC Liaison

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

# High Attendance Marks Seattle Biofouling Symposium

## New On-Site Data Advances Biofouling Understanding Significantly

While only 125 attendees were expected several days before the October 10th OTEC Biofouling and Corrosion Symposium in Seattle, a total of 161 paid registrations were received, with 146 actually attending. The event was well organized, smoothly run, and held in accommodations which were not only comfortable, but also very well suited for cross-exchange of information. Discussion between speakers and listeners was also well facilitated. The organizers of the conference, a joint effort by the OTEC Biofouling and Corrosion Project Office of Battelle, Pacific Northwest Laboratories and the Solar Energy Division of the US Department of Energy, were "very satisfied with the presentation, discussions, and participation".

*Subjects discussed at this symposium have to do with heat transfer, macro- and microfouling, corrosion problems, material selection, inorganic film deposition, ocean engineering, and various other things that pertain to these topics. We think that the exchange of ideas between industry, government, and university people will help us achieve the objectives for this symposium, which are to transmit such information and from that lead to the successful development, then, of OTEC technology.*


# The OTEC Liaison

VOLUME 1 NUMBER 3
OCTOBER 1977


Prior to the conference, there was a general impression by some in the OTEC community that biofouling and corrosion had been exaggerated in their potential impact and impairment of efficient OTEC systems. However an analysis of data from several research sites that were reviewed just prior to the meeting and then reported on clarified many of these questions and one detailed later in this article.

Lyle D. Perrigo, manager of the OTEC Biofouling and Corrosion Project Office of Battelle Northwest, made the following summary at the outset of the conference:

*A rather thin film of biofouling can have a tremendous effect on heat-exchanger efficiency. A film about 2 mils thick would lose something like 15 to 30% of the heat-transfer efficiency. Normally, in the industrial world, we compensate for those things by speeding up the pumps to give a greater water velocity or put in some more heat-transfer surface to accommodate that kind of a loss. Since we are talking about very very large heat exchangers, we want to minimize the matter of building more of it to take care of this problem; and since we are living on our own power, or parasitic power, every time we speed up the flow through the tubes, there is a correspondingly greater loss in efficiency.*

*There is a need for cleaning, and we're going to have to come up with a mechanical technique, a chemical technique, or alteration of the environment so we can keep these heat exchangers in efficient operation.*

### MISCONCEPTION CLARIFIED

A typical misunderstanding regarding biofouling was cleared up at the conference. One speaker defended his point of view that biofouling was not a serious problem, using the example that power plants in Puerto Rico did not use any chlorination whatsoever. Donald Sasscer of the University of Puerto Rico's Center for Energy and Environment Research offered the information that 4,000 megawatts of power plants were, indeed, in use in Puerto Rico, and all used seawater in their condensers. But, he said, this was not to infer that there was no biofouling. Sasscer pointed out that there is so much macrofouling that the microbiofouling is of minor importance, so that they have to totally shut down the power plants to physically clean out the tubes in order to keep them in operation. The earlier spokesman then volunteered that when they were building the first nuclear plant for Puerto Rico, all the people told him was "Chlorine? Forget it. We don't need it." (!)

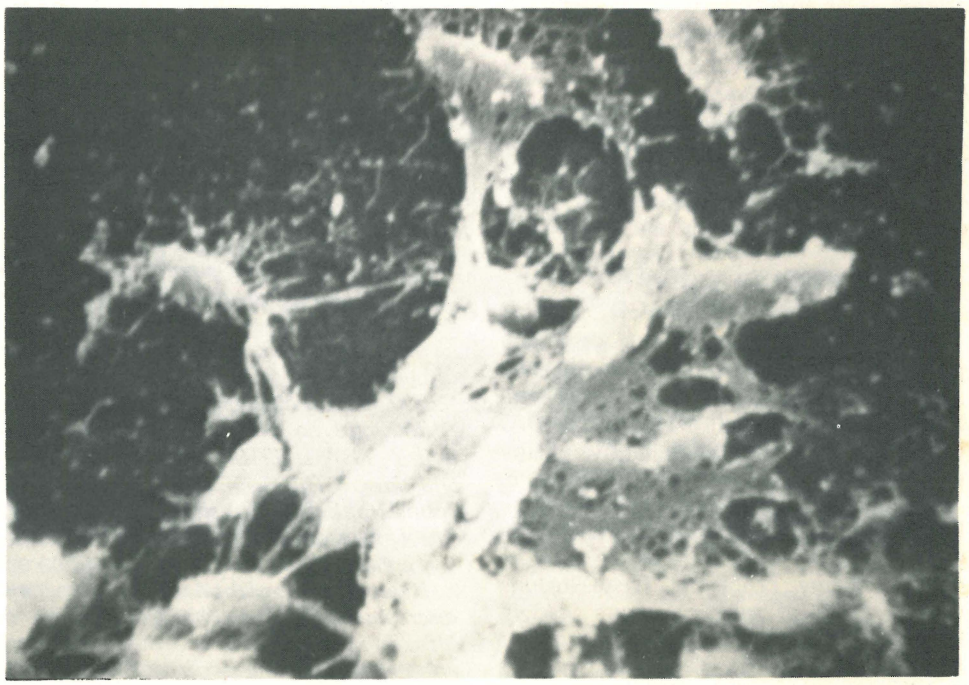
### HIGHLIGHTS OF PAPERS

A total of 41 papers were presented, and it was not the intention of this publication to presume to abstract this abundance of information and the many discussions that ensued. However, several highlights are excerpted for readers, as follows:

Most conventional power plants, not all, that have installed either the MAN or Amertap cleaning systems also continue to use chlorination. There are a few, however, that have backed off on chlorination. The discussion of monomolecular (Teflon-like) coatings has been considered, however their longevity and durability in use and their effect on heat-transfer efficiency have not been determined, though they are being investigated.

**(Continued on Page 4)**

## OTEC'S "PUBLIC ENEMY NUMBER 1"?



**The above electron micrograph was one of many presented in Seattle illustrating what biofouling really looks like. While esthetically beautiful, microfouling organisms such as these present problems which will have to be resolved to maintain OTEC efficiency.**

# The OTEC Liaison

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

**VOLUME 1 NUMBER 3**
**October 1977**

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## Please Subscribe!

**Due to tardiness in the distribution of the October issue, the "early bird allowance" of $10 off the regular subscription rates offered as an inducement in the last issue is extended until December 15th, 1977.**

*The OTEC Liaison* will provide continued *liaison* [from the French: *an instance or means of communication between bodies, groups, or units*] to the community of ocean thermal-energy conversion, with response to your expressed needs. Your comments and criticisms are welcomed.

### ENERGY EXHIBIT OPENS IN CHICAGO

"Energy Lab", a new exhibit partially powered by energy from the sun, opened recently in the Museum of Science and Industry in Chicago. Provided by ERDA/DOE, it is the most comprehensive energy exhibit in the nation in a major museum.

Included in the 5,000-square-foot exhibit are displays featuring concepts and devices which can contribute to the solution of our energy problems. These include various types of solar collectors used in heating and cooling systems, techniques for turning coal into clean-burning gases and liquids, power plants that use temperature variations in the sea to generate power, windmills, and geothermal energy systems.

## Letters to the Editor

**A prime function of this newsletter is to provide a forum for cross-exchanges. The Editor of The OTEC Liaison has always been convinced that any two (or more) individuals with intelligence, imagination, and a knowledgeable background can adequately support widely-divergent points of view. Many correspondents suggested the inclusion of critiques to keep the newsletter lively and slightly controversial, and William D. Metz's OTEC report in the October 14th issue of Science has elicited quite a response toward that end. Several readers' comments are therefore repeated below.**

*October 27th, 1977*

*For your coming issue, may I comment on William D. Metz's OTEC report in the October 14th issue of* Science?

*The undersigned "OTEC Advocate" couldn't agree more with this statement in the report: "There has not been sufficient evaluation of alternative types of OTEC systems to justify the present program direction." We need to build and test several complete plants, at least on the scale of Claude's cuba plant, before we can have any "program direction". It is doubtful that we need such an animal at all.*

*Meanwhile, I am stumbling over the words "OTEC Advocate". According to both the Marine Board Commission and Mr. Joplin of Florida Light and Power, this "OTEC Advocate" appears to be one single gruesome monster, lacking experience and of sinister intent.*

*To me, "OTEC Advocates" range from people who for the past 29 years have worked on OTEC and are well aware of its 100-year history—to engineers who have worked on it for 17, 10, 5, 3 years and even non-engineers. How can all these be so completely unable to evaluate the system? Why do the Marine Board Commission or Mr. Joplin rate so much higher in their evaluating efforts? Did they secretly steal from their employers time to keep abreast of OTEC technology for more than 29 years? Every one who has worked on OTECs has so far become an "OTEC Advocate". Is this sinister? Or is it because OTEC is after all rewarding when you know it?*

*The Commission and Mr. Joplin even discuss* cost. *Which cost? Lockheed's $2500 per KW built, moving down to $1300 and on down as more plants are built? TRW's $2100, also moving down and down? The Applied Physics lab of the Johns Hopkins University's $700 per KW? The University of Massachusetts' $800 per KW? Solar Sea Power's $166 million for a 100-megawatt plant? Why these large discrepancies? Have the Commission or Mr. Joplin studied the reason? Reasons are: Heat exchanger surface prices vary from $1.50 to $9 per square foot, all firm bids. Heat transfer coefficients vary from less than 400 to 1000, all verified by tests. Temperature differences in the oceans mean even more.*

*"Bryn," said Lockheed's Trimble to me, "The first plant will cost a lot. If we have the guts to build a second anyway, we will build thousands." That is the problem in a nutshell. We have never achieved anything without taking chances. There is nothing wrong about the "miscalculations" referred to about nuclear plants—except if they scare us into* not risking *OTEC tryouts. We are now in a downward spiral in our technology as well as our economy, thanks to the fear of taking chances. The present proposal by Professor Heronemus of the University of Massachusetts to spend two billion this year and more later marks a cheap way to determine our energy future. Or we may go down as a well-intentioned but too weak and wobbly entity.*

*Bryn Beorse*
*Sea Water Conversion Laboratory*
*College of Engineering*
*University of California, Berkeley*
*Richmond, California 94804*

(Other readers have forwarded comments on Metz's *Science* article to *The OTEC Liaison* which will be published in the next issue.)

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### SCHLESINGER OPENS DEPARTMENT OF ENERGY

The Department of Energy opened its doors October 1st as Secretary of Energy James R. Schlesinger marked the event at the DOE temporary headquarters. Unveiling the DOE signplate, Schlesinger said: "For all of us it will be a challenge to respond to what are the emerging needs of the American people and this country. It is both a challenge and an opportunity. To resolve our energy problems, the United States will have to go through a transition along with other nations of the world. Through the effective work of all the people of this department, we expect to rise to that task."

The new department was proposed by President Carter on March 1st, 1977, to provide the framework for carrying out national energy policy. On August 4th, 1977, the Department of Energy Organization Act was signed into law, and the following day Schlesinger was confirmed by the Senate as the first Secretary of Energy.

Among the major programs under the new department are conservation, resource development and production, research and development, data management, environment, and regulation. With a first-year budget of $10.4 billion, the Department has inherited nearly 20,000 employees under this government reorganization. DOE will be located in the James V. Forrestal Building, 1000 Independence Avenue SW, Washington DC 20545.

# INTERNATIONAL NEWS

News and information on what is happening internationally on OTEC and other forms of ocean energy have been sought by *The OTEC Liaison* since its inception in the spring of this year. Communications in this regard are hampered not only by language barriers and slow mails, but also by delays in learning which foreign-government officials and agencies are assigned to organize and allocate information. Gradually, however, news is beginning to trickle in, and some is provided below. A brief summary via an ERDA spokesman is as follows:

France and Germany have little or no interest in OTEC specifically. Japan, a sea-oriented nation, has many research projects underway in various ocean-energy and related fields, including heat-exchanger experiments and phosphate deposits among others. Israel has several projects, partially reported in this issue. Iran is not interested in large technology at the present time. Several US firms are working with Ivory Coast nations. India is investigating various forms of ocean energy, including OTEC, as is Australia.

## JAPAN BUILDS FLOATING FACTORY

A floating pulp factory is being completed by the Ishikawajima-Harima Heavy Industries Company for a Brazilian firm. Designed for ultimate use in the Jari River, an offshoot of the Amazon, the plant will utilize much of the technology developed for OTEC and other floating entities.

Complete with its own power plant, the $218 million facility will be constructed on two barges, each about 150 feet wide by 650 feet long. One will carry the basic pulp-making equipment, while the other will accommodate a thermal-power generator plus some recovery devices. Together they will be capable of producing 825,000 tons of bleached kraft pulp daily. They will be towed from Japan to Brazil early in 1978, and the journey is expected to take three months.

A pioneer of both freshwater and ocean-going floating factories, the Japanese firm says it is already working on plans for factories for steel making, desalination, cement production, and natural-gas liquefaction.

## FIELD WORK OFF BRAZIL

Eugene H. Kinelski of DOE informed the Seattle biofouling conference that "it is most likely" that some field work will be done off the coast of Brazil, with the recent resurgence of interest in a floating OTEC option. He also said "OTEC-1 might well serve as an instrument platform for study." The DOE spokesman said they would certainly want to know what the ambient and effective conditions are in that area.

## ENGLAND REPORTS ON OCEAN-ENERGY RESEARCH

After many months of attempting to learn what the United Kingdom is doing about ocean energy, *The OTEC Liaison* recently received an informative letter from Clive O. J. Grove-Palmer, Group Leader of the Ocean Energy Group of ETSU, the Energy Technology Support Unit of Britain's Institute of Oceanographic Sciences in Wormley. ETSU is managing a number of R&D projects on renewable sources of energy for the UK's Department of Energy. These include solar, wind, tides, and waves. Mr. Grove-Palmer's group is responsible for ocean-energy studies including OTEC, salinity gradients, ocean currents, and sea waves. After a preliminary study of the potential value to the UK of ocean thermal energy, currents, and salinity gradients, the conclusion was that "at present we could not sensibly put forward an R&D program proposal".

What the UK has, however, is a very vigorous program on ocean waves. The UK provides the Chairman of the International Energy Agency Wave Power Working Party, with Mr. Grove-Palmer as the UK delegate. The USA is represented on that working party by Professor M. E. McCormick of the US Naval Academy. Both McCormick and Grove-Palmer have been invited to present papers to the 1978 Houston Offshore Technology Conference in May. (See the calendar in this issue.) *The OTEC Liaison* has both the 1976 and the 1977 press releases on this program should readers have further interest.

## JAPANESE INVESTIGATE OTEC

In Japan a team led by Dr. Harvuo Uehara of Saga University (in Saga City) is testing a device called "Shiranui (Sea Fire) Number Three". It is a small model, using artificially-heated and artificially-cooled water to simulate different temperatures of sea water, which produces up to one kilowatt. *The OTEC Liaison* has attempted for several months to obtain further information, without success to date. However the aid of the Japanese Consulate has recently been enlisted, and additional details are anticipated in an early following issue. Also, Dr. John G. Fektovich of Carnegie-Mellon University is planning a January trip to an energy conference in India, with hopes of a visit to Japan to confer with researchers there on OTEC progress.

## JAPANESE ENDOW MIT

The Massachusetts Institute of Technology recently received a $200,000 endowment from Kawasaki Heavy Industries Ltd. for research on high-strength materials for ocean structures, including their fabrication. Included will be advanced techniques such as electron-beam and laser processes in conjunction with welding criteria.

## ISRAELIS DEVELOP SEA-WAVE DEVICE

A small working model of a wave-conversion device has been built by Anthony Peranio of Israel's Institute of Technology, otherwise known as Technion, in Haifa. Peranio believes a large-scale converter would work, ideally as a combination of a port's breakfront and a desalination installation. The scientist's wave machine consists of a long inclined ramp onto which the waves would rush up and into a holding tank. The kinetic energy would thus be converted to potential energy by controlling the water from the tank to a conventional turbine from which electrical energy would be extracted. Peranio projects that an effective converter would require a length of approximately 3500 feet. The civil-engineering professor claims that his machine is "incredibly simple in design and concept". Additional details are being sought by *The OTEC Liaison* and will be reported as available.

## JAPAN'S SOLAR RESEARCH

A team of Japanese visitors toured several US heating and cooling demonstrations this summer and presented an overview of the Japanese solar-energy program to ERDA staff members. Japan's solar-research budget for 1977 totals about $5 million and covers heating and cooling, solar thermal electric production, photovoltaic technology, and some ocean thermal research.

## ISRAEL'S SALINE-GRADIENT RESEARCH MOVES AHEAD

While Israel's shores have only a marginal delta-T, all but eliminating any potential for OTEC in that area, research and development in the field of saline-gradient ponds is receiving a great deal of attention. In fact, a 7500-square-meter building that will be air-conditioned by an adjacent 1500-square-meter pond is now under construction.

## ITALIAN FIRM STUDIES CABLES

The Department of Energy has entered into negotiations with Pirelli of Milan, Italy to investigate the feasibility of using a bottom cable in a full-scale ocean-test platform. The firm will do several preliminary bottom-cable designs.

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MANNED OPEN SEA RESEARCH PLATFORMS will be discussed in a one-day workshop on November 18th. For information contact Jan Witte or Bobby Seiwitt, Nova University, Ocean Science Center, 8000 N. Ocean Drive, Dania FL 33004; (305) 587-6660.

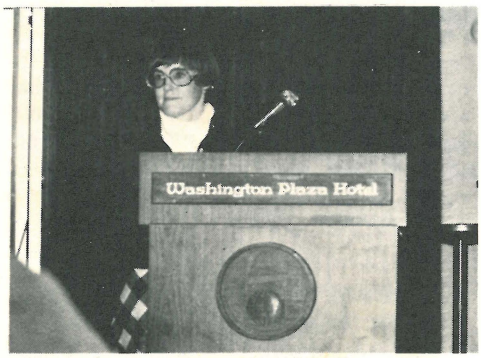
## HIGH ATTENDANCE MARKS SEATTLE BIOFOULING SYMPOSIUM

(Continued from Page 1)

### FOULING AFFECTED BY FLOW RATE AND SURFACE CONDITION (ROUGHNESS)

A joint paper by Fetkovich, Grannemann, Mahalingam, and Meier of Carnegie-Mellon University and Munchmeyer of the University of Hawaii suggests several conclusions: "The biofouling builds slowly, but at an increasing rate. It is apparently very easy to clean the tubes, but the fouling grows back faster afterwards. Fouling rates apparently either increase when long inlet pipes are part of the apparatus, or are rather sensitive to surface condition (roughness). Finally, the accumulated fouling appears to be sensitive to flow variations."

This group has been advocating mounting several tests on an existing oil-production rig in the Gulf of Mexico, and has obtained the agreement of a major oil company to do so at no cost. Cold-water data could also be obtained in this way at 1/3 to 1/10 the cost of alternative methods, and in a much shorter time, these researchers suggest.




**Dahlia Hagel of Hydronautics ponders an attendee's question.**

### MICROFOULING DATA EXHIBITS STRIKING REGULARITIES

In a paper presented by John G. Fektovich of the Department of Physics of Carnegie-Mellon University, it was pointed out that "The early data on microbiofouling under OTEC conditions exhibit striking regularities." This information was contained in five recently-obtained sets of biofouling data: three sets taken at Keahole Point, Hawaii (aluminum tubes at 3 and 6 ft/sec flow, titanium tube at 6 ft/sec) and two sets taken at St. Croix, Virgin Islands (aluminum at 3 and 6 ft/sec) under a wide variety of conditions. These included not only different flow velocities and different wall materials, but also quite different histories of passage to the test section.

At Keahole, the tests were submerged about 50 feet, and the seawater entered the units directly. At St. Croix, on the other hand, the units were mounted on board a moored barge. The water was pumped up from a 30-foot depth through intake hoses. "Among other effects, this means the organisms experienced much more severe pressure drops in the St. Croix apparatus (almost 60 feet of water) than in the Keahole case (about 5 feet of water). It is heartening that the fouling data are already beginning to show surprising regularities even in the face of significant differences in experimental conditions."

The subject of ozonation created a lively discussion between Dahlia Hagel of Hydronautics and Herb Schlesinger of Gibbs and Hill regarding vast differences in the estimated costs of this method of biofouling retardation. Their dispute had not been resolved at the time this issue of *The OTEC Liaison* went to press, but it was learned that ozonation is not, in fact, used in conventional power plants at present. It is, however, used somewhat in waste water treatment plants. Ken Bell pointed out that "the OTEC plant is circulating something on the order of fifty times the amount of water of an equivalent size of conventional power plants", and therefore comparisons of these plants to proposed OTEC installations must be used with caution.

Air injection is used widely now in refineries, as is freshwater in some installations, but both offer uncertain solutions.

(Continued on Page 5)

**Pleasing accommodations enhance efficient communication in Seattle.**

**COMPARISON OF ALTERNATIVES**
**OTEC BIOFOULING CONTROL 300 MWe**

| Alternative | Installed Capital Cost $ Million | Annual Operating Cost $ Million | Present Worth Cost $ Million | Space Required Square Feet |
|---|---|---|---|---|
| Chlorination (Gas) | 1 | 0.75 | 10 | 1000 |
| Bromine Chloride | 1-2 | 1.0 | 13-15 | 1000 |
| Chlorination (Electrolytic) | 4-5 | 0.8 | 16-18 | 1000 |
| Balls or Brushes No Chlorination | 10 | Negligible | 17 | 10,000 |
| Coral Injection | 1-2 | 1-2 | 13-26 | 5000 |
| Ozonation | 7-8 | 0.75 | 20-22 | 5000 |
| Chlorine Plus Chlorine Dioxide (Electrolytic $Cl_2$) | 6-8 | 2.0 | 33-36 | 2000 |

**The above table was reproduced from a slide presented in Seattle by H. A. Schlesinger of Gibbs and Hill Incorporated of New York.**

## SEATTLE SYMPOSIUM
(Continued from Page 4)

**H. A. Schlesinger of Gibbs and Hill answers questions while Session Chairman W. A. Corp of Barnard College and Columbia University looks on.**

Chlorination appears to be the best possibility, but in the concentrations needed to be effective it may cause some environmental problems regarding animal life in surrounding waters, despite its biodegradability.

Surrounding the entire issue of biofouling is the fact that little deep-water research has been done to date, and the concentration of microorganisms in deep water is relatively unknown. One researcher did point out, however, that work done by the Naval Applied Science Laboratory resulted in the conclusion that the "concentration of organisms on the ocean bottom is practically sterile".


**W. A. Corp and Lyle Perrigo of the Symposium's Organizing Committee**

### TENTATIVE CONCLUSIONS

Probably the highlight of the Symposium was the results of the papers of the University of Hawaii and Carnegie-Mellon University outlined above. Several cautious conclusions are that (1) biofouling is not as severe as a lot of people thought, (2) it looks easier to remove, and (3) it seems to be more uniform in severity than many believed. That is, you can change a lot of conditions and the biofouling doesn't change much. It appears to be generally the same in one place as in another, the same whatever velocity you use and whatever material is used. The basic picture, then, is that the biofouling situation is beginning to look very much simpler and easier to understand than it looked a few months ago.

## FEASIBILITY STUDY OF TRANSPORTING OFFSHORE OTEC-PRODUCED ENERGY TO SHORE BY THERMAL MEDIA

The feasibility study described above, prepared by B. Yudow, A. Konopka, and N. Biederman of the Institute of Gas Technology, has been received by *The OTEC Liaison.* Published this October, it was prepared for the Division of Solar Energy of ERDA/DOE under contract Number E(49-18)-2426 for the period November 1976 through July 1977 of Project 8980, and is the Third Topical Report. The abstract of the study appears below.

### ABSTRACT

Thermal-energy media were considered as both methods of storage and of transportation of OTEC-derived energy. Three types of thermal-energy storage media were considered for transport of OTEC energy: (1) sensible-heat media, which depend upon the heat capacity of the material for energy storage; (2) latent heat of fusion materials; and (3) reversible chemical reactions, which depend upon the change in energy content of certain compounds as chemical bonds are broken and other bonds are made.

The characteristics of the storage medium, configuration, and materials, the system energy storage density, system thermal losses, heat-engine efficiency, and cycle temperature are specified. The unit capital costs of storage, transport ships, and heat engines are also discussed. The methodology for the economic evaluation of the thermal-energy transport system is also described. A description of the ship transport concept and the economic evaluation methodology and resultant costs for delivered thermal energy and electricity are given.

Costs of onshore electricity using OTEC-produced thermal energy (8¢ to 34¢/KWhr) are high. Costs of thermal energy transportation are higher than current process heat costs, but are still comparable. The initial degradation of OTEC-produced shaftpower to heat followed by transmission and reconversion to electricity results in low overall energy transmission efficiencies and high unit energy costs.

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## "SPARTAN" DOE HEADQUARTERS?

The Administration's new Energy Department is in the process of moving into a $17 million facility, but top personnel aren't going to the limits of rules regarding creature comforts. Secretary Schlesinger's office is 50 square feet less than allowable. However, he will have a shower, conference room, and kitchen—but no private dining room. Deputy Secretary O'Leary is allowed a shower, but won't get one. A spokesman for DOE insists that it is a "lean move".

# CONTRACT AWARDS

**Several respondents to the April questionnaire suggested that current RFPs and contract awards for OTEC-related subjects be regularly listed in The OTEC Liaison. While no current RFPs were indicated by our sources, we have listed below some recent contract awards by the government. This is not to be construed, however, as a complete list.**

**Oct 26: Study of Fouling and Corrosion Problems in a Solar Sea Power Plant:** EY-76-S-02-4041.A0003 for $252,000 to Carnegie-Mellon University, 5000 Forbes Ave., Pittsburgh PA.

**Oct 26: Equipment to Enable the Processing of Satellite Sea Surface Thermal Information More Efficiently by an Order of Magnitude:** N00014-75-C-0173, 27 Sep 77 (no RFP) for $74,500 to University of Miami, PO Box 8007, Coral Gables FL.

**Oct 27: Studies of OTEC One Dynamics, Cold Water Pipe Loads and Structural Requirements:** EY 76-C-02-2681.A001 for $47,508 to Hydronautics, Inc., 7210 Pindell School Road, Laurel MD.

**Oct 27: At Sea Incineration, Sampling, Analysis, and Environmental Assessment:** 68-02-2660, RFP DU-77-A129 for $499,485 to TRW Inc., One Space Park, Redondo Beach CA 90278.

**Oct 27: Solar Production of Industrial Process Hot Water Using Shallow Solar Ponds:** Cost-sharing Contract EG-77-C-03-1475 for $461,806 to Teledyne-Brown Engineering, Cummings Research Park, Huntsville AL.

**Oct 27: Dynamic Analysis of Offshore Structures, 12-month research program:** 14-08-0001-17202 for $76,131 to Massachusetts Institute of Technology, 77 Massachusetts Ave., Room E19-702, Cambridge MA.

**Oct 28: Bottom Segment Design of Underwater Cable Power Transmission System:** EG-77-C-05-5360 for $126,115 to Pirelli Cable Systems, Inc., 245 Park Ave., New York, New York 10017.

**Oct 28: Riser Segment Design of Underwater Cable Power Transmission System:** EG-77-C-05-5359 for $194,760 to Simplex Wire and Cable Co., PO Box 479, Portsmouth NH 03801.

**Nov 1: Security Assessment of Power Systems Including Energy Storage:** EC-77-S-02-4206.A0001 for $397,818 to Purdue Research Foundation, Lafayette IN.

**Nov 2: Energy Analysis of the Base Materials Utilized in Electric Power Transmission Systems:** EC-77-C-01-5043 (Unsolicited Proposal) for $272,000 awarded to Arthur D. Little, Boston MA 02441.

**Nov 2: OTEC 100 MWE Alternate Power System Study:** EG-77-C-03-1473 for $426,294 to Westinghouse Electric Corp., Power Systems Co., Philadelphia PA 19113.

# 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 might wish to contact conference organizers for reports of proceedings.**

**Oct 10-12:** OTEC Biofouling and Corrosion Symposium, Seattle WA. Info: Dr. Robert H. Gray, Chairman, Symposium Committee, Battelle Pacific-Northwest Laboratories, PO Box 999, Richland WA 99352; (509) 946-2937.

**Oct 17-19:** OCEANS '77, joint conference of Marine Technology Society and Institute of Electrical and Electronics Engineers, Bonaventure Hotel, Los Angeles CA. Info: OCEANS '77 Headquarters, PO Box 17669, Los Angeles CA 90017.

**Oct 27:** American Oceanic Organization luncheon, Washington DC. Info: (703) 527-0888.

**Oct 31-Nov 3:** Energy and the Oceans Symposium, Sonesta Beach Hotel, Key Biscayne, Miami FL. Sponsored by the Institute on Man and the Oceans Inc. with the Bureau of National Affairs. Topics include tidal energy, ocean thermal and solar energy, offshore oil and gas exploration, and offshore nuclear-power plants. Fee: $200. Info: Thomas R. Post, Institute on Man and the Oceans Inc., PO Box 012436, Flagler Station, Miami FL 331011; (305) 379-7660.

**Nov 3-5:** Coastal Society third annual meeting, Washington Plaza Hotel, Seattle WA. Theme: "Energy Across the Coastal Zone". Info: T. Terich, Dept. of Geography, or M. L. Schwartz, Dept. of Geology, Western Washington State College, Bellingham WA 98225.

**Nov 3-6:** Energy Fair '77, Anaheim CA. Info: Shirley Solomon, Energy Fair Inc., 15915 Asilomar Blvd., Pacific Palisades CA 90272; (213) 459-1050 or (213) 459-2777.

**Nov 6-8 (date moved up from Nov 10-12):** National Ocean Industries Association Board and Committee Meeting, Hilton Head SC. Info: NOIA, Suite 410, 1100 17th Street NW, Washington DC 20036; (202) 785-5116.

**Nov 14-15:** Symposium on Insurance and the Diving Industry, New York City. Info: Marine Technology Society, 1730 M Street NW, Washington DC 20036; (202) 659-3251, or William G. McDonald, Maritime Association of the Port of New York; (212) 425-5704.

**Nov 14-17:** 11th Annual Conference, Law of the Sea Institute, Univ. of Hawaii, Honolulu HI. Topics include regionalism and UNCLOS III, regional management of the ocean, and marine resources. Info: LOS Institute, Univ. of Hawaii, 2549 Dole Street, Homes 401, Honolulu HI 96822; (808) 948-8686.

**Nov 16-20:** 10th Annual Meeting of the Sea Grant Association, New Orleans LA. Hosted by the Louisiana Sea Grant Program. Info: Stanley R. Murphy, President, Div. of Marine Resources, Univ. of Washington, Seattle WA 98195; (206) 543-6600.

**Nov 11-20:** International Solar Energy Society international congress, Delhi, India. Info: International Group Specialists Inc., 2500 Wilshire Blvd. (Suite 738), Los Angeles CA 90057; (213) 387-4317.

**Nov 17:** American Oceanic Organization luncheon, Washington DC. Info: (703) 527-0888.

**Dec 5-7:** Alternative Energy Sources: A National Symposium, Miami Beach FL. Info: T. Nejat Veziroglu, Director, Clean Energy Research Institute, Univ. of Miami, PO Box 248294, Coral Gables FL 33124.

**Dec 15:** American Oceanic Organization luncheon, Washington DC. Info: (703) 527-0888.

**Jan 23-27:** Deep-Sea Oil Production Structures Course, Univ. of Calif., Berkeley CA. Info: Continuing Education in Engineering, University Extension, Univ. of Calif., 2223 Fulton St., Berkeley CA 94720.

**Feb 12-17:** 144th National Meeting of American Association for the Advancement of Science, Washington DC. Info: AAAS Meetings Office, 1776 Massachusetts Ave. NW, Washington DC 20036; (202) 467-4487.

● **Feb 20-22:** 5th Ocean Thermal Energy Conversion Conference, Miami Beach FL. Info: T. Nejat Veziroglu, Director, Clean Energy Research Institute, Univ. of Miami, PO Box 248294, Coral Gables, FL 33124.

**Feb 27-Mar 1:** 5th Energy Technology Conference and Exposition, Sheraton Park Hotel, Washington DC. Info: Energy Technology Conference Inc., 4733 Bethesda Ave. NW, Washington DC 20014; (301) 656-1090.

**Mar 5-10:** Oceanology International '78, Brighton, UK. Info: Conference Secretary, OI 78, BPS Exhibitions Limited, 4 Seaford Court, 220-222 Great Portland Street, London W1N 5HH, England.

**Mar 7-8:** The Working Diver 1978, Battelle Columbus Laboratories, Columbus OH. Info: c/o Betty Alkire, Battelle-Columbus, 505 King Ave., Columbus OH 43201; (614) 424-7648.

**May 8-11:** 1978 Offshore Technology Conference (OTC), Astrohall, Houston TX. Info: Offshore Technology Conference, 6200 N. Central Expressway, Dallas TX 75206.

**Aug 21-24:** 2nd World Hydrogen Energy Conference, Zurich, Switzerland. Info: Walter Seifritz, Chairman, 2nd World Hydrogen Energy Conference, Swiss Federal Institute for Reactor Research, CH-5303 Wurenlingen, Switzerland.

# NEWSBRIEFS

## NEW PRIVATE FIRMS ENTER OTEC FIELD

*The OTEC Liaison* has been informed that three firms have recently entered the development of OTEC. They are Pacific Power and Protein of California; Solar Marine, AG of Stuttgart, Germany; and Deleval of Sweden. Deleval has set up an American subsidiary for the purpose of building OTEC heat exchangers, and has hired Bill Heronemus of the University of Massachusetts as a consultant.

A telephone call to Dr. Heronemus on October 31st resulted in the confirmation that he is on leave from the University of Massachusetts for one year. He is working with the Swedish firm's new Energy Systems Division of Alfalaval Thermal, Incorporated, which is one of the five groups of Deleval Separator Company. Deleval Separator Company is the United States operating company for Alfalaval, AB of Sweden.

Further information on Pacific Power and Protein and Solar Marine is being sought, and will be reported as early as available. The entry of private industry into the OTEC field will undoubtedly serve as a great catalyst toward development of OTEC as a viable alternative energy source.

## TWO NEW CONTRACTS AWARDED

Eugene H. Kinelski of DOE announced at the conference that two new environmental assessment studies are now under way, one with the Interstate Electronic Corporation on environmental assessments of OTEC-1, the Hughes Mining Barge conversion, and the other with Lockheed's Center for Marine Research for biological and ecological program planning.

## BIOFOULING LESS OFFSHORE?

In a paper presented by Pamela C. Springer of Lockheed's Ocean Laboratory in San Diego at the Marine Technology Society's mid-October conference in Los Angeles, it has been suggested that biofouling usually decreases further offshore. Ms. Springer indicated that "evidence is emerging that the slime buildup on structures in the open ocean may be much less than that experienced near shore". Details of her paper may be obtained from the MTS office in Washington or from *The OTEC Liaison's* Chicago office.

**COMING IN NEXT ISSUE**

**PHOTO REPORT OF ARGONNE'S HEAT-EXCHANGER RESEARCH**

**REBUTTAL OF CONTROVERSIAL SCIENCE ARTICLE**