11-1-1982

Volume 6, Number 11 (November 1982)

The Solar Ocean Energy Liaison

Solar
OCEAN ENERGY
Liaison

INCORPORATING
The OTEC Liaison

VOLUME 6, NUMBER 11
November 1982

ENERGY SECRETARY RESIGNS

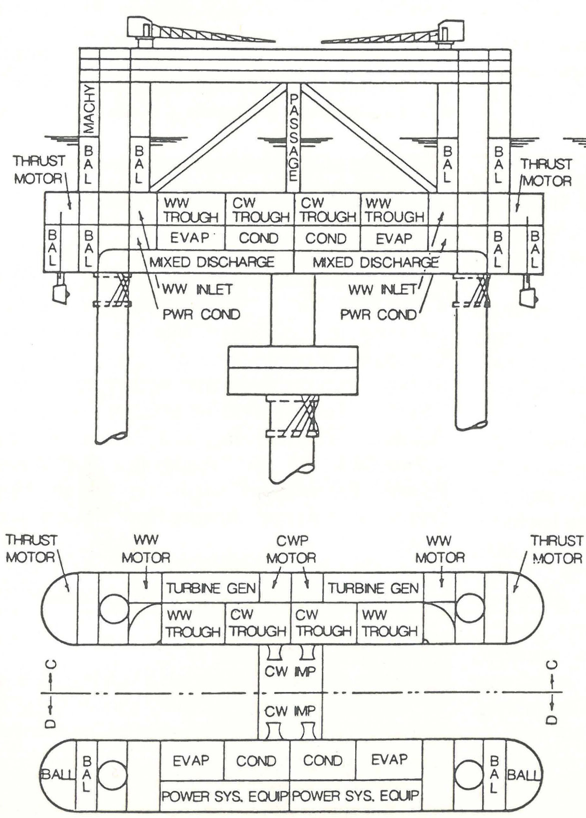
On November 5th Secretary James Edwards officially resigned as the top man in the Department of Energy, and President Reagan promptly announced his selection of Donald Hodel as a replacement. Permanent appointment will not occur until the Senate returns from its recess at the end of November.

Edwards' resignation resulted in part from his frustration at not being able to dismantle the Department of Energy—a goal proclaimed by Reagan during his election campaign. Edwards was a staunch supporter of such programs as the Clinch River Breeder Reactor and regulatory reform in the atomic-energy industry. During his terms in office, Edwards repeatedly came under criticism from environmentalists and alternative-energy advocates.

Edwards' replacement, Donald Hodel, a close friend of Interior Secretary James Watt, had been serving as Under-Secretary of the Interior since February 1981. Hodel also has often been criticized by environmentalists, but unlike his predecessor he is experienced and knowledgeable on energy subjects. He has served as administrator of the Bonneville Power Administration, and as a member of the Board of Trustees of the National Electric Reliability Council, the Board of Directors of the Electric Power Research Institute, the Executive Committee of the Western Systems Co-ordinating Council, the Advisory Committee on Energy Facility Siting of the National Science Foundation, and the Board of Directors of the National Committee of the World Energy Conference.

Hodel has a history of strong support for energy-conservation programs. At a recent press conference, the new Energy Secretary said he doesn't plan any major effort to scale back the Department of

(continued on Page 2)



SWP Configuration

FIGURE 1-A

(Note: The following is the second in a series of monthly articles covering recent OTEC-platform concept developments.)

GIANNOTTI AND ASSOCIATES MOORED PIPE/MOBILE PLATFORM

An innovative approach to the floating OTEC platform has been developed by Jonathan Ross and Joan Watts of Giannotti and Associates in support of NOAA's OTEC Technology Development Program. Known as the Moored Pipe/Mobile Platform, or MP-squared concept, this design is unique in that the self-propelled platform can be disconnected from the permanently-moored cold-water pipe and submarine cables.

The focus of the design study was an engineering evaluation of two aspects of the MP-squared concept: the disconnect capability and the potential of decoupling of surface-platform motions from the cold-water pipe (CWP). The disconnect capability was seen as advantageous because the platform could be moved from the site in case of storms and for shore-side inspection, maintenance, and repair. As a result, the platform-systems hardware would not have to be designed to withstand 100-year storm conditions or to last the 30-to-40-year lifetime of the plant (or be capable of at-sea replacement).

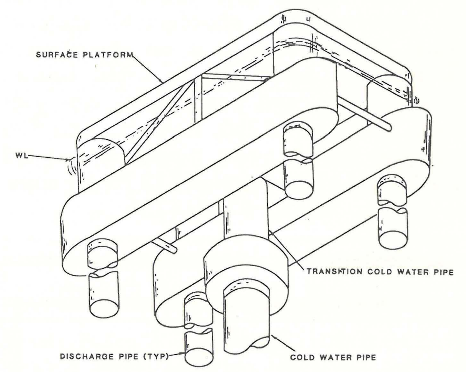


FIGURE 1-B SWP Configuration

At the start of the study, the capability to decouple platform motions from the CWP through the use of a flexible or gimballed transition CWP was viewed as a possible means of reducing the loads on (and thus the risk to) the CWP. But as the

(continued on Page 3)

Solar
OCEAN ENERGY
Liaison

INCORPORATING
The OTEC Liaison

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 6, NUMBER 11
November 1982

EDITOR/PUBLISHER
Richard Arlen Meyer

ASSISTANT EDITOR
Philip E. Haring

TYPESETTER AND COPY EDITOR
Shelly Treshansky

ART DIRECTOR
Pamela Greenfield

SUBSCRIPTION MANAGER
Mildred Ward

RESEARCH
Patricia Belisonzi Dodge

OCEAN ENERGY
is published monthly by Popular Products Incorporated at 1303 South Michigan Avenue, Chicago, Illinois 60605, USA. **Subscription prices are as listed below: United States and possessions: one year \$150, two years \$250. Foreign: Add \$20 per year for air mail. Single copies: US \$12.50 per copy. Foreign \$13.75 per copy.**
USSN: 0162-8755

SOLAR OCEAN ENERGY

NEW PRODUCTS

New Fouling Monitor Developed With Potential OTEC Applications

After 16 months of development in a joint program conducted by Montana State University and EPCO Incorporated of Danbury, Connecticut, a computer-based fouling monitor with potential application to OTEC systems was put on the market in June 1982. The ELF-1000 (ELF stands for energy loss and fouling) is designed to continuously monitor the accumulation of organic and inorganic deposits in an active conduit. The unit can simultaneously monitor all types of fouling, including biofouling, chemical-reaction fouling, corrosion fouling, crystalline fouling, and particulate or sedimentation fouling.

The monitor operates by measuring the effects of fouling on frictional resistance and heat-transfer resistance in an active conduit. The system is applicable to OTEC heat-exchanger design selection, and can aid in the optimization of OTEC plant efficiency and operations.

The ELF-1000 consists of three components: a tube assembly, computer-interface electronics, and a computer subsystem. The tube assembly is composed of an instrumented tube selected to match the alloy of concern, and an electronic box that interfaces all analog diagnostics with the computer-interface electronics. The tube contains ports for pressure-drop measurement and a heat-transfer section containing an electrically-heated aluminum block which simulates the heat source, as well as temperature probes to determine heat-transfer efficiency.

The computer-interface electronics component is designed to convert the analog signals from the tube assembly into a digital format acceptable to the computer. Similarly, the digital computer output is converted to analog commands needed by the tube assembly to control the flow rate and heat flux as desired. This component can handle up to four tube assemblies at one time.

The computer subsystem is composed of an Apple II microcomputer, a video monitor screen, and a disk data-storage system. This component calculates, displays, and stores data on the frictional resistance and heat-transfer resistance in the tube assembly, and issues commands for the automatic control of flow rate and heat flux. The system output data includes run time, bulk temperature in and out, inner-radius block temperature, inside tube-wall temperature, pressure differential, flow rate, total heat-transfer coefficient, friction factor, Reynolds number, heat-flux fouling factor, and selectable system command and control diagnostics.

The ELF-1000 is designed to test or verify design concepts for the following parameters: metallurgy, flow rates and shear stress, heat flux and surface temperature, other surface characteristics, geometry, residence time, and treatment methods.

The ELF-1000 is currently in use at several sites. A power company has used the system to select condenser-tube alloys and to determine flow requirements and maintenance schedules. The unit is now being used to measure biofouling in the operational power plant. The machine is also being used by a chemical-treatment company to evaluate the effectiveness of new products and to show customers how the treatment is working.

The ELF-1000 can provide valuable information for selection of OTEC heat exchangers, determination of the effectiveness of various fouling-control options, and calculation of life-cycle and maintenance-schedule components. In addition, the unit can provide on-line data for maximizing plant-operation efficiency in commercial OTEC facilities.

For further informattion write to John R. Moll, EPCO Incorporated, Building 101, Middle Quarter, Woodbury, Connecticut 06798.

SECOND JAPANESE SAIL SHIP COMMISSIONED

The *Aitoku Maru,* sister ship of the *Shin Aitoku Maru* in service since 1979, was recently commissioned by Nippon Kokan (NKK) and the Aitoku Company. The 1600 DWT (deadweight ton) chemical and oil carrier has a sail mounted near the bow to provide auxiliary sail power which will result in fuel savings. The sail is made of fiberglass-reinforced plastic with steel frames, and measures 8 by 10.6 meters.

The sister ship of the new vessel has realized a 10% energy savings as a result of the use of auxiliary wind power. Contracts have now been signed for the design of two more 2100 DWT auxiliary sail vessels to be used in Japan's coastwise trade.

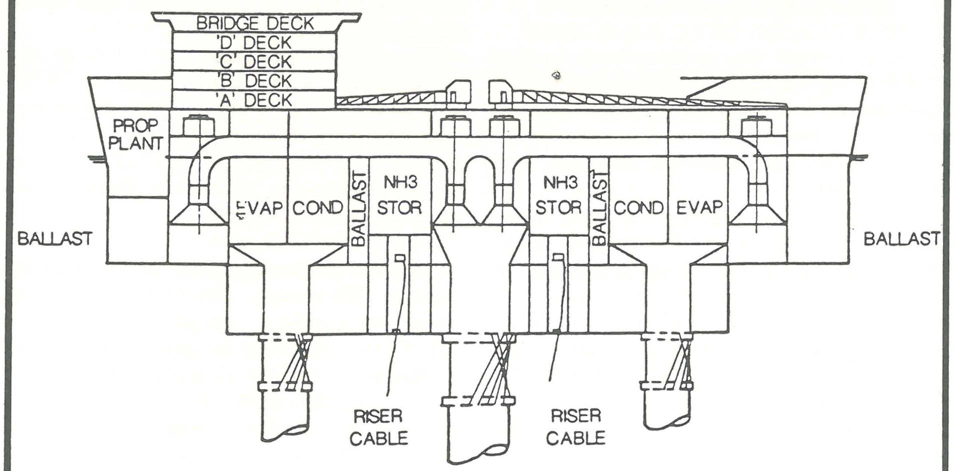
RECENT PATENTS ISSUED

Three patents were issued recently in the field of ocean energy: Patent Number 4,327,296 for a "Wave-Powered Motor", assigned to Lockheed Missiles and Space Company Incorporated of Sunnyvale, California; Patent Number 4,327,297 for a "System for Generating Energy From Tidal Activity" (California); and Patent Number 4,248,044 for an "Apparatus for Wave-Power Generation Utilizing Large Mass Dynamic Energy Absorption" (Connecticut).

(continued from Page 1)
Energy's operations. He also suggested that he would oppose further sharp cuts in spending on alternative-energy and other research projects.

Ocean Energy will follow the nomination hearings when the Senate reconvenes, and will report any ocean-energy news which might emerge.

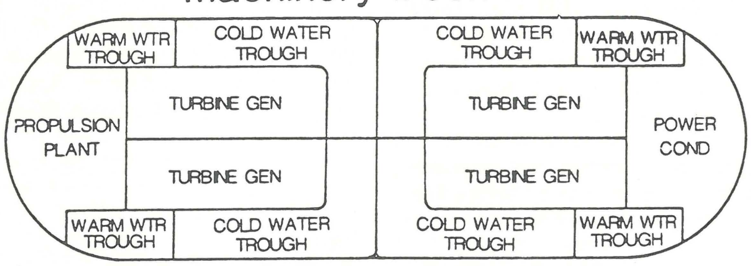
Inboard Profile



LWP Arrangements

FIGURE 2-A

Machinery Deck Plan



(continued from Page 1)

analysis revealed, this did not occur in all cases.

For the purpose of evaluating the MP-squared concept, two candidate platforms were developed. One hull configuration is in the shape of a ship, known as the Large Water Plane (LWP). The other is in the form of a catamaran semi-submersible known as the Small Water Plane (SWP). In developing the concept designs, and in the model-testing program, a range of surface-platform designs was considered with overall lengths ranging from 399 to 662 feet for the LWP and from 369 to 631 feet for the SWP. These platforms support OTEC plants in the range of 40 to 460 megawatts.

In both configurations, the surface platform was connected to the CWP by means of a transition platform. The transition platform acts as an interface between the surface platform and the CWP, provides buoyancy to support the CWP when the surface platform is disconnected and off-site, and is the platform to which the mooring system and riser cable are attached.

For the LWP configuration, the transition platform was connected directly to the surface platform. For the SWP, a transition CWP and transition riser cable linked the two platforms. The objective at the outset of the SWP study was to assess the decoupling of the CWP from surface-platform motions by the transition CWP. After study and model testing, the transition CWP was found not to provide such decoupling.

Using parametric analysis and computer simulation, the SWP configuration shown in Figure 1 was developed. The twin-hull form is similar to present offshore oil-rig designs. The lower hull houses the power system, propulsion equipment, and ballast. The superstructure houses the habitability and control facilities, maintenance shops, and helicopter pad.

The final machinery arrangement in the hulls places evaporators and condensers outboard side by side. The turbine-generator is inboard next to the seawater troughs and above the heat exchangers, keeping the turbine-generators near the heat exchangers to minimize piping losses. The support equipment and ammonia storage are located under the turbine-generator and next to the heat exchangers.

The cold-water plenum is placed in the center of the platform, next to the condensers, so that the cold water comes into the plenums and radiates into the cold-water troughs. Warm-water troughs are in front of the evaporators, and bring warm-water feed to the evaporators. Once the plant's output exceeded 100 megawatts, extra turbine-generators and heat exchangers were added. Plant sizes of 40, 50, 100, 200, and 400 megawatts were developed using this approach.

Two candidate materials were selected for the construction of the surface platform: steel and concrete. Since the SWP surface platform is designed with a complicated column-truss cross-structure system which could develop high loads at its joints, steel was chosen as the material best suited to this application.

LWP Configuration

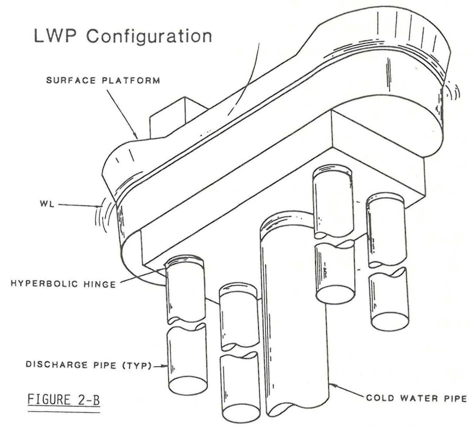


FIGURE 2-B

For both the SWP and the LWP, a fiberglass-reinforced plastic/syntactic foam sandwich with stiffening rings placed along its length was chosen as the best CWP design. Both configurations also used a multi-leg catenary mooring system, because it provides the lowest technical risk and also accommodates depth changes of the transitional platform between surface, operational, and deep depths.

The primary differences between the SWP and the LWP are in the surface platform and, as noted earlier, in the transition platform/surface platform interface. The hull form of the LWP design was a modification of the Applied Physics Laboratory (APL) plantship design. Heat-exchanger pods were incorporated into the hull design, not externally as in the APL design.

The freeboard was increased both fore and aft with flare beginning five feet below the waterline and continuing all the way up to the sheerline. This was done to reduce the frequency of shipping water on deck. Circular-shaped waterplane endings were incorporated to reduce wave slap and impact loads on the bow, and also to re-

(Any readers who would like to submit information for inclusion in this series of articles on OTEC platforms should call or write Philip Haring at OE. This is an open-ended series covering technical and economic aspects, and will continue as long as information continues to come in.)

(continued on Page 4)

(continued from Page 3)

duce resistance while in the mobile mode of operation. The hull form was made up of simple shapes so fabrication and construction would be easy and inexpensive. The LWP is diagrammed in Figure 2.

The area below the main deck of the LWP houses all the power-system and propulsion-system equipment. All other facilities are located in the deckhouse. The power system for the LWP follows the same symmetric quadrant approach as the power system for the SWP. Power-conditioning equipment is located in the bow, and propulsion equipment in the stern.

Concrete was selected as the construction material for the LWP surface platform because of its lower construction and maintenance costs and known ship-construction properties.

Models of both the LWP and SWP concept designs were tested in the Hydronautics Ship Model Basin. They were subjected to the sort of operational and 100-year storm-wave loadings which would be present at the Puerto Rico OTEC site. The models were instrumented to provide measurements of platform motions and mooring-line loads. A series of 84 runs were made varying wave heights, headings, platform configurations, and test-tank mooring equipment.

The test results indicate that both MP-squared versions would survive the storm loadings while moored and while disconnected from the moor. The LWP configuration operated well in large sizes, but in smaller sizes its motions were at times too extreme for OTEC-plant operations. The SWP configuration operated well in all sizes tested.

The results of the design study and model test can be briefly summarized as follows: Major disadvantages of an MP-squared floating OTEC system are requirements for on-board propulsion or towing capabilities, and additional risk in meeting plant-availability criteria (such as 90% on line) if disconnect/reconnect evolutions are required. Major advantages include enhanced platform survivability for storm conditions using the disconnect mode, reduced maximum CWP loadings via disconnection from the surface platform, and improved life-cycle maintenance for the OTEC power plant through use of shore-based inspection, maintenance, and repair facilities.

The MP-squared study was conducted from a technical viewpoint only: that is, no specific cost calculations were made. Co-author Ross noted, however, that MP-squared initial costs would probably be higher than those of a permanently-moored floating OTEC platform, but that life-cycle costs would be lower.

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 4: Design, Fabrication, and Testing of a 12,000-Gallon-Per-Day Reverse-Osmosis Desalination Plant Consisting of Prototype System Design, Prototype System Construction, Test Phase, and Shipboard Installation and Test Phase: Data are required. RFP N00024-82-R-4462 to be issued. Commander, Naval Sea System Command, Washington DC 20362, NAVSEA 0241, Jack Dennard, (202) 692-8201.

Oct 4: Dissemination of Passive and Hybrid Solar Technology to the Private Sector: Contract DE-AC-02-81-CS-30635 A001, for $162,306, awarded to the Potomac Energy Group Incorporated, 125 Royal Street, Alexandria, Virginia 22314. US Department of Energy, Chicago Operations Office, Acquisition and Assistance, 9800 South Cass, Argonne, Illinois 60439.

Oct 4: Research Proposal for Energy Policies for the 1980s: Contract DE-AM-01-79-PE-70106.A009, $196,358, awarded to Harvard University, Cambridge, Massachusetts 02138. US Department of Energy, Office of Procurement Operations, Washington DC 20585.

October 5: Development of an In Situ Optical Settling Chamber for Measuring Settling Rates of Suspended Marine Sediments Near the Deep Sea Floor: Negotiations are being conducted with Sea Tech Incorporated, PO Box 779, Corvallis, Oregon 97330. See Note 46. Contract Negotiator J. Adams, (202) 696-4510. Department of the Navy, Office of Naval Research, Arlington, Virginia 22217.

Oct 5: Perform Lab and Field Experiments to Investigate Radar Imaging of Oceanic Short-Gravity Waves: Negotiations are being conducted with TRW Incorporated, TRW Defense and Space Systems Group, One Space Park, Redondo Beach, California 90278. Contract Negotiator C. Davis, (202) 696-4510. Department of the Navy, Office of Naval Research, Arlington, Virginia 22217.

Oct 5: Provide Consultation for All Modifications and Upgrades of the Laser Radar and Ocean Optics Ground Truth, Perform Analysis of LIDEX FY-82 Data, and Begin an Analysis of the LIDEX for Anti-Submarine Warfare: Negotiations are being conducted with the Pacific-Sierra Research Corporation, 12340 Santa Monica Boulevard, Los Angeles, California 90025. Contract Negotiator C. Davis, (202) 696-4510. (272) Department of the Navy, Office of Naval Research, Arlington, Virginia 22217.

Oct 5: Analysis of Wave-Crest Elevations: Modification M005 to Contract H-4771, for $99,532, jointly awarded September 22nd, 1982, to Anderson & Nichols, Camp Dresser and McKee, and New England Coastal Engineers, Boston, Massachusetts. Federal Emergency Management Agency, 500 C Street Southwest, Washington DC, 20472.

Oct 5: Investigation of the Mechanics of Seawater Sampling: Contract N66001-82-C-0453, for $114,111, awarded September 20th, 1982 to EG&G Washington Analytical Services Center, 2150 Fields Road, Rockville, Maryland 20850. Naval Ocean Systems Center, San Diego, California 92152.

Oct 17: Development of Fouling-Resistant Membrane Modules for Reverse Osmosis: Contract 14-34-0001-2421, for $113,000, awarded to Bend Research, Incorporated, 64550 Research Road, Bend, Oregon 97701-8599. Bureau of Reclamation, Office of Water Research and Technology, 18th and C Streets Northwest, Washington DC 20240.

Oct 20: Expanded Oceanographic Investigations on Hawaiian Geophysics: Contract N00014-82-C-0380 (no RFP), for $280,344, awarded September 17th, 1982 to the University of Hawaii, 2650 Maile Way, Honolulu, Haaii 96822. Contract Negotiator S. Ware, (202) 696-4508. Office of Naval Research, 800 North Quincy, Arlington, Virginia 22217.

Oct 20: Completion of South Atlantic OCS Physical Oceanography Synthesis: Contract AA851-CT2-61 (RFP AA851-RP2-23), for $423,755, awarded September 29th, 1982 to Science Applications Incorporated, 1200 Prospect Street, La Jolla, California 92038, for the period ending January 31st, 1984. US Department of the Interior, Bureau of Land Management, Branch of Contract Operations, Code 851, 18th and C Streets Northwest, Room 2447, Washington DC 20240.

Oct 21: Analysis of the Ocean Bottom Seismograph (OBS) Coupling Data Acquired in the Keehi Lagoon Test Using Calibrated Mechanical Transients, Sine Waves, and Other Known Excitations: Negotiations are to be conducted with Rondout Associates Incorporated, PO Box 224, Stone Ridge, New York 12484. See Note 46. Contract Negotiator C. Davis, (202) 696-4510. (288) Office of Naval Research, 800 North Quincy, Arlington, Virginia 22217.

Oct 22: Fatigue Performance of Repaired Marine-Grade Aluminum-Alloy Weldments: Contract N00167-82-C-0183, for $259,987, awarded to the Aluminum Company of America, Alcoa Laboratories, Alcoa Center, Pennsylvania 15069. David Taylor Naval Ship Research and Development Center, Bethesda, Maryland 20084.

Oct 25: Continue the Development of New Techniques for Seawater Sampling on a Fine Space and Time Grid and Establish a Flow Cytometry for Oceanic Optical Properties: Contract N00014-82-C-0043 (no RFP), for $189,264, awarded September 13th, 1982 to the Northeastern Research Foundation Incorporated, Bigelow Laboratory for Ocean Sciences, McKown Point, West Boothbay Harbor, Maine 04575. Office of Naval Research, 800 North Quincy, Arlington, Virginia 22217.