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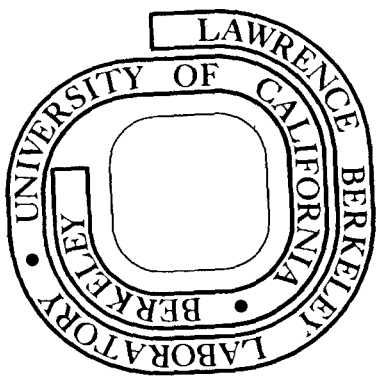

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PROGRAMMATIC ENVIRONMENTAL IMPACT ASSESSMENT FOR OPERATIONAL OTEC PLATFORMS - A PROGRESS REPORT

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Abstract

As the Ocean Thermal Energy Conversion (OTEC) Program advances toward commercialization, the potential environmental impacts of large-scale development must be assessed. Design modifications that will mitigate or reduce potentially adverse effects must be identified and incorporated into the design configurations. In the second phase of Interstate Electronics' OTEC Environmental Impact Assessment Program, sponsored by the Department of Energy, the key issues associated with the deployment and operation of demonstration- and commercial-size plants are under evaluation.

Presently, three platform design configurations are being considered:

- A 10 to 20 MW_e land-based plant
- An industrial plant-ship operation
- A 20 to 400 MW_e moored plant

In the program, the land-based plants are to be located on tropical or subtropical islands, while the plant-ships would graze in the open ocean, producing ammonia, hydrogen, or other energy-intensive products. The moored platform will transmit electricity through a cable to a shore-based distribution point.

In this assessment, both individual platforms and a mix of the above are being considered for potential siting in the thermal resource regions. The key issues considered may be generically grouped into three categories:

- Social, economic and institutional impacts
- Environmental impacts
- Health and safety on and adjacent to the platforms

While this program is not complete, the major findings to date are presented.

Introduction

With the construction of the preoperational Ocean Thermal Energy Conversion (OTEC-1) Platform underway, it is time to evaluate the social, economic, and environmental issues associated with the operation of several demonstration- and commercial-size OTEC platforms. The previous environmental impact assessment, published in March 1979, specifically considered the potential environmental effects associated with OTEC-1.[1] This environmental impact assessment, underway since January 1979, is programmatic in nature, considering several different plant designs for siting in a variety of geographic regions.* Report publication and Program completion date is scheduled for December 31, 1979.

Objectives

This Programmatic Environmental Impact Assessment is performed in compliance with the National Environmental Policy Act requirements for the preparation of a detailed environmental report that addresses the environmental effects of the OTEC Program.

If, through the preparation of this Environmental Assessment, significant potential impacts are deemed likely to occur, a Programmatic Environmental Impact Statement will be prepared.

Approach

The approach taken to prepare this Environmental Impact Assessment calls for the definition of the candidate designs for OTEC commercial-size platforms and an oceanographic characterization of the potential siting locations. Once these components are defined, the key issues associated with overlaying the platform on the environment are evaluated. In the succeeding sections, the philosophy behind the approach will be presented.

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* The Oceanic Engineering Division of Interstate Electronics Corporation was awarded Subcontract 450101 by the Lawrence Berkeley Laboratories to prepare the Programmatic Environmental Impact Assessment.

Platform Configuration

In selecting a region or site within a region for locating an OTEC platform, the configuration must be considered. Three principal platform configurations are under consideration in this assessment: moored, land-based, and a grazing plant-ship operation. Over the past years a multitude of studies have been funded by various government agencies to examine the different components for an OTEC platform.[5,6] From the available information, the environmentally significant design components were selected and the design options were listed in matrix form to illustrate the large number of combinations possible.

Various combinations of these components and options will be examined for their environmental acceptability specific to each of these three platform configurations.

Site Selection

The candidate regions for OTEC development in this study are listed in Table 1 for each platform configuration.

For site selection tiering, the siting of each platform is driven by the type of platform and the environment. The suitable environmental characteristics may be ranked as follows:

- Minimal Siting Criteria
- Economic Feasibility
- Social Issues
- Potential Environmental Consequences

With these basic criteria, the most preferable sites can be identified for each type of OTEC platform. For these, the critical impacts associated with each can be examined. Within the next paragraphs, the tiering components for each of these criteria are briefly described.

Minimum Siting Criteria

The three components that are the principal driving forces in siting OTEC plants are:

- Thermal Resource availability of at least 20°C annual average
- Oceanographic currents not exceeding 60 cm/sec (moored and plant-ship only)
- Relatively low frequency of occurence of extreme meteorological conditions

TABLE 1. CANDIDATE REGIONS FOR SITING OF THE THREE TYPES OF OTEC PLATFORMS

PLATFORM CONFIGURATION			REGION
Plant-Ships	Land-Based	Moored	
x	x	x	Hawaiian Islands
x	x	x	U.S. Trust Territories, including Guam, American Samoa, and the Marianas Islands
x	x	x	Puerto Rico and the Virgin Islands
x		x	Gulf of Mexico, including the states of Florida, Alabama, Louisiana, Arkansas, and Texas
x			South Atlantic $\geq$200 miles off the coasts of Brazil and Africa
x			Central America $\geq$200 miles off the coast in the Pacific

The thermal resource requirements have been defined as 20°C annual average between the surface and deep-ocean waters. These candidate areas of the world have been determined and graphically illustrated by the Department of Energy.[7]

The locating of a platform in the presence of strong oceanographic surface or subsurface currents is not feasible because of the strains imparted on the cold water pipe (CWP), and the mechanisms for holding position or maneuvering may exceed the operational power available. The maximum current speeds acceptable for siting in this study have been arbitrarily defined as 60 cm/sec; siting speeds in excess of this will consume too much energy.

Low annual frequencies (less than 3 percent) of extreme meteorological weather frequencies and associated sea-states as a result of typhoons or hurricanes are a desired trait of a OTEC site.

Economic Feasibility

Paramount after identifying the candidate locations for OTEC siting is the economics surrounding plant installation, operation, and maintenance:

- Present and projected power requirements
- Potential for industrial growth
- Market potential for the energy-intensive

products
- Resource availability to satisfy power requirements

Only after sifting through these components can the right plant be positioned in the location. The present and expected future power requirements must be identified for each region. Additionally, the power requirements of potential industries that may develop in each locale should be explored to adequately describe the power requirements. Of concern for OTEC platform siting is the market potential of the energy-intensive products. Considerations include the availability of raw materials to make a final product, the cost to produce the product, the market demand of the product, and the distance to the market. For instance, the tourism industry will inevitably be developing for the Marianas Islands, and the availability of OTEC-type power may serve as an incentive to development.

As a further example, the richest deposits of manganese nodules are located approximately 600 to 1,000 miles southeast of Hawaii, in water depths of 2,200 m.[8] The processing of manganese nodules by the hydrochloric-acid-leach process to extract nickel, cobalt, copper, and manganese requires chlorine gas, ammonia, and electric power. A chlorine plant is presently in the planning phase in Hawaii, but the current high costs of electricity still pose an obstacle to processing. A plant-ship OTEC platform could work in conjunction with a deep-ocean mining platform.

Another economic consideration is the availability of other power-producing alternatives. Areas that have other stronger potential energy resources available (i.e., geothermal) should be deferred to those areas with lesser options.

Social Issues

Once the minimal siting and economic feasibility criteria are established, the social concerns take a lead role in determining siting feasibility:

- Proximity to U.S.
- Aesthetics (visual nuisance)
- Cultural conflicts

In this study, the area within the 200-mile economic resource zone (ERZ) surrounding the United States and its territories and possessions is under

evaluation. Surrounding the Pacific Trust Territories, and encompassed within the ERZ, is the highest ΔT water in the world. Plant-ships are considered to graze the world's oceans beyond the 200-mile ERZ of other countries.

Of further consideration is the visual effect an OTEC power plant has on the coastline of the candidate regions if the candidate regions for either a moored or land-based plant are located in high tourism environments. An OTEC plant approximately 70 m high would be visible 28 km offshore to an individual at sea level. From a building 20 stories high, the OTEC would fall below the horizon 56 kms away. In this event, as in Long Beach, California, the platforms would have to be architecturally pleasing to both residents and tourists, thus adding additional considerations to design.

Additionally, the presence of sacred or culturally significant areas may preclude OTEC siting.

Environmental Issues

To minimize the environmental consequences of siting an OTEC platform within an area, the environmentally significant design options available will reduce or mitigate the potential environmental impacts.

The key environmental issues may be divided into the following generic categories[9]:

- o Institutional/management issues
- o Oceanographic site/region characterization
- o Impact evaluation
- o Monitoring to evaluate impact
- o Health and safety

The forward planning of OTEC considerations about the environmental features of a specific region will preempt or mitigate severe environmental conflicts.

There are numerous so-called institutional or management issues that play a major role in plant siting, not the least of which is the coastal zone management (CZM) plans or policies, and the discharge or siting Federal Permit. Most of the U.S. territories have completed their CZM EIS's, but these studies require very close scrutiny to evaluate potential conflicts.[10]

On an international basis, the Law of the Sea negotiations have not resolved the OTEC-related issues. How the UN may be affected by OTEC development must be applied in turn to those OTEC-applicable areas.

To fully evaluate the potential environmental impacts of OTEC development, data for several candidate areas are being pooled and classified in generic and oceanographic terms by their predominant features.

Environmental impacts will be evaluated from these data to describe a typical tropical nearshore and tropical offshore environment.

Environmental issues can be divided into air quality, water quality, and land effects. Air quality effects include the release of carbon dioxide, ammonia, chlorine, and other gases from the plant. Water impacts include: platform attraction, ocean mixing redistribution from ocean mixing of nutrients and temperature, organism impingement and entrainment, maintenance releases of oil and grease and wastewater, cable and mooring implantation, working fluid leaks, and biocide release. Land effects may result from construction and changes in land use. Each of these issues is presently under thorough evaluation. Progress to date for each will be presented for the generic platforms.

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