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ENVIRONMENTAL ASSESSMENT AND MONITORING PROGRAM FOR OCEAN THERMAL ENERGY CONVERSION (OTEC)

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ABSTRACT

Ecologically sound operations of projected Ocean Thermal Energy Conversion (OTEC) plants can be insured by careful attention to the marine environment during the design phase. This requires quality information from regions of potential OTEC interest. Currently, preliminary or actual surveys and laboratory studies are being conducted in the waters of Puerto Rico, the Gulf of Mexico, Hawaii, and Guam for potential moored OTEC plants and in the equatorial South Atlantic for proposed plant-ship operations to provide such benchmark and baseline data. These data plus existing archival information can be used to model effects of OTEC operations based on projected design schemes. Four major areas of concerns (1) redistribution of oceanic properties, (2) chemical pollution, (3) structural effects, and (4) socio- legal-economic; and 11 key issues associated with OTEC deployment and operation have been identified. In general, mitigating strategies can be used to alleviate many deleterious environmental effects of operational problems as biostimulation, outgassing, etc. Various research studies on toxicity, biocide releases, etc., are under way or are planned to investigate areas where no clear mitigating strategy is available. A Master Plan listing procedures to be followed to identify and evaluate potential concerns at any OTEC proposed site is proposed for discussion and refinement in advance of any real OTEC test operations.

As the OTEC program enters the hardware phase with the deployment of the one megawatt equivalent test platform (OTEC-1) in 1980, the environmental data required for permitting and eventual design for commercialization is becoming more extensive and more sophisticated. The programmatic environmental assessment was issued in early 1980 and the generic environmental assessment for the next test platform (OTEC 10/40) will be completed by the summer of 1980 to be available prior to contract award. One year's monitoring at benchmark sites in the Gulf of Mexico (Tampa and Mobile); Puerto Rico (Punta Tuna); Hawaii (Kona Coast/OTEC-1); and at the grazing ship site (Equatorial South Atlantic) have been completed. Archival studies have begun for Guam and a new benchmark site (southwest Oahu) will be occupied in early 1980. Data from these sites will be analyzed to be available to aid in site selection for future test deployments.

PURPOSE

The goals of this paper are to present a logical strategy for the evaluation and eventual monitoring at Ocean Thermal Energy Conversion (OTEC) sites or regions so that both the effects of an OTEC plant on the environment, and the influence of the environment on OTEC operations can be assessed.

This should result in information which can be used by engineers, designers, and planners to insure practical, safe, and efficient operations of any OTEC plant and provide sufficient justification for operational permits for OTEC plants from the involved regulatory agencies.

OTEC PROGRAM

Ocean Thermal Energy Conversion is a technology using the temperature difference between warm surface and cold deep water to produce electric power with a gas or steam turbine. An OTEC plant can be operated in either a "closed" or "open" cycle. In the closed cycle configuration, warm surface water heats an evaporator containing an appropriate working fluid, and the vaporized working fluid drives a gas turbine. After passing through the turbine, the vapor is condensed by cold deep water and then returned to the evaporator for re-use (Fig. 1). In the open cycle configuration, sea water is used as the working fluid, warm surface water being brought to a boil in a partially evacuated evaporator and the steam produced being used to drive the turbine. Once again, cold deep water is drawn up to condense the steam after passage through the turbine.

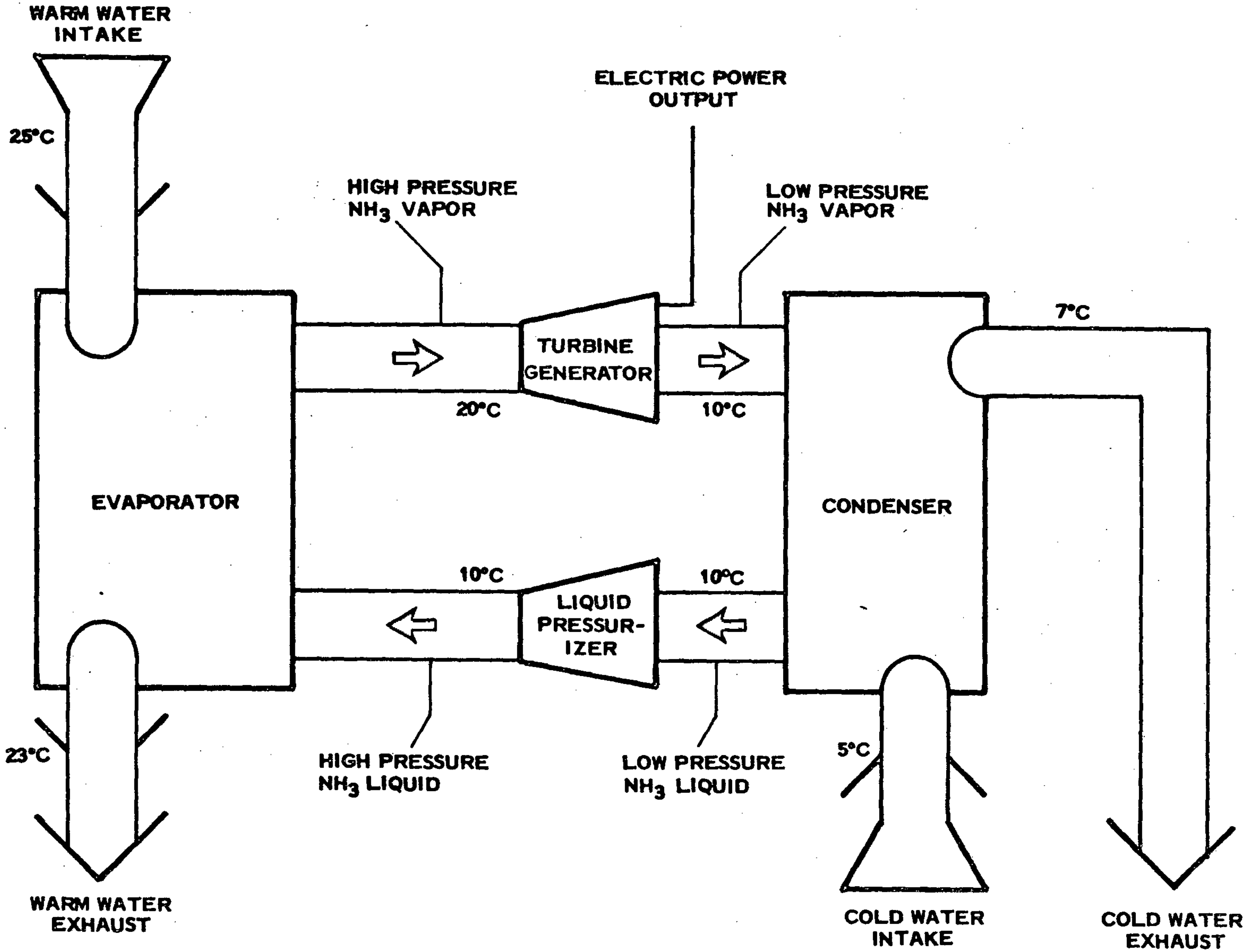
OPTIONS

At present there are three basic options proposed which use OTEC systems:

(1) Moored/electric - the OTEC plant is attached to the bottom with a combined mooring/electrical transmission cable. The OTEC plant is used to generate electricity which is connected to the power grid system via a submarine transmission line. In essence the OTEC plant is at a fixed geographic location, so its effects would be a point source in the horizontal plane and a line source in the vertical plane. With the present considerations of (1) 20^{o} C temperature as the limiting case for the commercial resource and (2) ocean engineering capabilities for size and mooring of potential OTEC plants; the depth of water for operating the moored electric OTEC plant is between 300 and 1500 M. Accordingly, the distance off-shore for the location of any potential OTEC plants would be a function of bathymetry or having the appropriate thermal resource in a designated range of depths of water. As the plant is moored its operations would come under the jurisdiction of the nearest nation regardless of the boundaries of any economic zone.

(2) Grazing/Manufacturing - the OTEC plant is located on a floating maneuverable platform or ship. The OTEC plant is used to generate power which in turn is used to manufacture a product such as hydrogen or ammonia from sea water, or alumina or aluminum from raw material brought to the ship. For the grazing/manufacturing option, the commercial product is not electricity but some goods exported via surface ships to markets. The plant with its own motive power essentially grazes the thermal resource without regard to bathymetry, except that the water depth must be greater than the depth of the cold water pipe. Obviously, this opens up a much larger area which can be used for OTEC. However, it vastly increases the area of potential concerns. With only a minimum depth limitation, the grazing plant could operate either in the economic zone of near-by nations or strictly in international waters. The environmental impacts of an operating OTEC grazing plant could be transferred by ocean currents into neighboring economic zones even though the plant itself was in

FIGURE 1
SCHEMATIC DIAGRAM OF CLOSED CYCLE OTEC POWER SYSTEM



international waters, thus potentially causing complex jurisdictional problems.

(3) Seaside/electric or manufacturing - this type of OTEC plant is land-based and the water is pumped to the generating plant either by pipelines along the sea floor, tunnels, or is delivered to the site as "waste" heat from a seaside power plant. Such a plant could generate power for the electrical grid or for manufacturing purposes as in the grazing option. This type of plant has the basic attributes of conventional seaside power plants so it would have the same environmental concerns.

ENVIRONMENTAL CONCERNS

The four major classes of environmental concerns and the key issues in these classes associated with OTEC deployment and operation are:

<u>Redistribution of Oceanic Properties</u>
Ocean water mixing
Impingement/entrainment
Climatic/thermal

<u>Chemical Pollution</u>
Biocides
Working fluid leaks
Corrosion

<u>Structural Effects</u>
Artificial reef
Nesting/migration

<u>Socio-Legal-Economic</u>
Worker Safety
Enviro-Maritime law
Secondary economic impacts

The potential changes in the oceanographic properties of sea water due to OTEC pumping operations are a major environmental concern. Because large amounts of cold, deep water and warm shallow water will be pumped to the heat exchangers, likely at some third depth; parameters such as temperature, salinity, density, dissolved oxygen, nutrients, carbonates, particulates, etc., will be modified by mixing with ambient ocean water in the vicinity of the eventual discharge. Discharges in the photic zone may cause biostimulation due to the increased nutrient contribution from the deep waters, with potential changes in either the size, relative abundance or species composition with respect to the resident marine population resulting in secondary effects on the food web. Displacement of sea water also could have toxic effects on ambient species by the introduction of trace chemical substances such as trace metals, organic decay products, etc., from other depths. Certain species, particularly those with low mobility, will be harmed by impingement/entrainment in the pumping system either by contact with the screens and walls of the pipe-heat exchanger system or by the pressure and temperature changes encountered in transit of the system from intake to discharge. Surface discharges may produce climatic effects by alteration of the air/surface water temperature ratio. Such an alteration, at sufficient scale such as in an OTEC park, could affect the microclimate by modification of locally generated winds and currents. Long-term operation of a large number of OTEC plants could result in reduced available heat due to the thermal extraction. Surface discharges also could enhance the release of CO_2 and other gases dissolved in cold deep waters with potential climatic effects for large-scale operations. This is particularly true for open cycle systems where gases, even normally dissolved in the surface ocean, must be separated from vaporized sea water so that gas bubbles do not impede plant efficiency. Such gases will be vented into the atmosphere potentially modifying the local microclimate as discussed above. However, subsurface discharges below the surface mixed layer in the pynocline could mitigate all or most of the potential problems associated with surface discharges.

Chemical pollution could result as functions of various OTEC plant operations and maintenance procedures. Of major concern are biocides proposed to keep the system components clean of biological growth. There are alternative ways (various mechanical systems) to clean heat exchanger systems, but these may not clean surfaces to the extent necessary for efficient operation. The major problem with biocides is the levels of concentration needed to impede biological growth in the system which unquestionably will affect organisms in the vicinity of the discharge. Furthermore, if chlorine is used as a biocide and ammonia as a working fluid, accidental combinations of these chemicals can produce compounds even more toxic to ambient organisms than the separate chemicals. Leaks of the working fluid of a closed cycle system also will pollute ambient ocean water. The effects and chemical fate of proposed working fluid leaks into sea water are not well understood. Ammonia, for example, is a nutrient in proper amounts and could stimulate marine growth complicating the biofouling problem. However, the excessive doses associated with a major leak is toxic both to marine and human life. Chemical pollution also will be produced by the corrosive effect of sea water passing through the heat exchanger system. Corrosion would produce metallic ions, and scale particles which could have direct toxic effects or long-term effects through incorporation of corrosion products into the particulate food supply of marine organisms through the process of bioaccumulation.

The physical presence in the ocean of a structure the size of an OTEC system itself has an impact on the ocean. The structure of whatever configuration will become an attractive habitat for a wide range of organisms based on experience from artificial reefs. The long-term effects of the structure on the environment will depend on the types, size, and abundance of the organisms attracted to or attached to the structure and this will modify the local population. Regional effects on populations might occur by either interference with, or modification of, nesting habits or migration pathways.

The first three major classes of concerns chiefly dealt with impacts on marine life. However, there are human consequences of OTEC operations which are grouped here as socio-legal-economic issues. Worker safety is of prime concern regulated by the Occupational Health and Safety Administration (OSHA) and the Coast Guard for strictly marine occupational concerns. Potential work hazards are the chemicals used or produced by the OTEC system such as ammonia, chlorine, foul weather during marine operations, collision, and systems accidents. Because of the novelty of OTEC operations, standard safety procedures will be augmented by procedures unique to OTEC. The siting of OTEC facilities either in international waters or where the downstream effects of

OTEC operations might intrude into international waters, will raise the issues of international rights and responsibilities beyond those treated by conventional maritime law and treaties. At present, the law of the sea is in a state of flux so that the resolution of potential international issues may be complicated and time consuming. Probably multilateral agreements or treaties among concerned parties, as is done for fishing rights, may be the interim solution of potential legal problems which may impede OTEC operations. Finally, the construction and operations of an OTEC facility may affect existing social and institutional structures. New jobs will be created and shore-based "boomtown" growth may occur with its associated impacts on housing, education, sanitation, etc. The electrical energy produced by OTEC plants may be transmitted to consumers either by A.C. or D.C. transmission lines. The cable needed to transmit this power could have impacts on marine ecosystems at the sea bed and at the shoreline. D.C. transmission will require two converter facilities, one at sea and one on shore, causing land use problems. If OTEC systems are used to produce energy-intensive products, they will produce air/water emissions typical of those produced in similar land-based industries.

The present and projected status of the resolution of these issues is listed in Table 1. Detailed discussion of these issues is found in the 1978 Environmental Development Plan (EDP) for OTEC.

PRESENT AND PROJECTED MONITORING PROGRAM

The monitoring strategies are designed for shipboard operations, manned platforms as well as instrumented buoys (Table 2). This program is to be integrated with those proposed by OTEC groups for biofouling and corrosion, and by NOAA for synoptic oceanographic parameters. An additional goal is to develop a packaged monitoring program which can be mobilized rapidly to aid in site selection for larger OTEC platforms (Fig. 2). Data collection and monitoring strategies will be done in view of compliance with NEPA and EPA, Corps of Engineers, Coast Guard, etc., regulations.

Specifically the program initiated pre-operational studies in four areas:

Hawaii - one site near Keahole Point
Puerto Rico - one site near Punta Tuna
Gulf of Mexico - regional survey using two station locations:
 (1) west of Tampa
 (2) south of Biloxi
South Atlantic - regional survey, 5-10^{o}S, 20-30^{o}W
and affected zone.

In the areas considered for the moored OTEC option - Hawaii, Gulf of Mexico, and Puerto Rico - a program has been initiated to take background data before placement of any operating OTEC system in these areas. This is required to insure that baseline information is available to evaluate the effects of OTEC on the ambient environment and to provide environmental data useful in the design of the operating system. At this time, only attractive thermal regions are known with any certainty. It is premature, therefore, to pick exact sites for potential OTEC plants until knowledge of other important environmental siting factors is obtained. Accordingly, for the initial studies each thermal region is divided into subregions in which it is expected

Table 1

ISSUES, REQUIRED RESEARCH, AND PROJECTS

ISSUES	REQUIRED RESEARCH	Status of Projects COMPLETED	CURRENT	PLANNED
OCEAN WATER MIXING	o Develop computer model to predict the impact of OTEC operations on oceanographic characteristics	2	3	3
	o Establish baseline oceanographic data at potential OTEC test sites	3	2	7
	o Characterize changes in oceanographic characteristics resulting from OTEC test operations	2	2	1
	o Determine impacts of oceanographic changes on site-specific marine ecosystems		4	2
IMPINGEMENT/ENTRAINMENT	o Search existing literature to determine extent of impact at similar ocean water pumping operations.		2	1
	o Monitor impacts at OTEC testing sites and define factors responsible for attraction of organisms		2	1
CLIMATIC/THERMAL	o Develop computer models to predict impacts of OTEC operation on micro- and macroclimate	2	2	1
	o Characterize site-specific climatic impacts resulting from OTEC test module operations	1	2	1
	o Determine potential increase in levels of atmospheric CO_2 resulting from OTEC operations			1
	o Determine potential microclimate effects of degassing during open cycle OTEC operations			

Table 1 (continued)

ISSUES	REQUIRED RESEARCH	Status of Projects		
		COMPLETED	CURRENT	PLANNED
WORKER SAFETY	o Develop worker safety programs for OTEC facilities using input from land-based facilities using/producing the same chemicals		1	1
	o Develop a warning system for OTEC facilities to prevent collisions with other ocean vessels		1	1
ENVIRO-MARITIME LAW	o Conduct survey of international law of the sea applicable to OTEC operations; update biennially	1		1
	o Conduct in-depth study of potential legal/institutional issues involving the particular site(s) chosen for OTEC operations			
SECONDARY ECONOMIC IMPACTS	o Assess the secondary impacts (e.g., land use, air/water emissions, solid wastes) associated with construction of OTEC plants		1	1
	o Assess the socioeconomic impacts of OTEC development	1	1	1
	o Assess the ecological and secondary impacts of electricity transmission			
	o Survey existing literature to characterize air/water emissions expected to be encountered in the production of chemicals at OTEC plants; develop applicable control technologies			1

Table 1 (continued)

ISSUES	REQUIRED RESEARCH	Status of Projects COMPLETED	CURRENT	PLANNED
BIOCIDES	o Survey existing literature to determine impacts of biocides on marine species		2	1
	o Monitor, sample, and characterize biocide discharges during OTEC testing operations		2	1
	o Conduct laboratory tests to determine the effects of varying levels of biocide use on marine ecosystems		2	1
WORKING FLUID LEAKS	o Survey existing literature to characterize impacts of various levels of potential working fluid leaks on marine ecosystems		2	1
	o Monitor, sample, and characterize the extent of working fluid leaks during OTEC operations		2	1
CORROSION	o Survey existing literature to determine effects on marine species of metallic element compounds discharged from heat exchangers constructed of various metals		2	1
	o During OTEC testing operations, monitor, sample, and characterize metallic elements discharged and dispersed into ambient ocean water, and determine the impacts of these discharges on indigenous marine species		1	2
ARTIFICIAL REEF NESTING/MIGRATION	o Define factors responsible for attraction of organisms		3	1

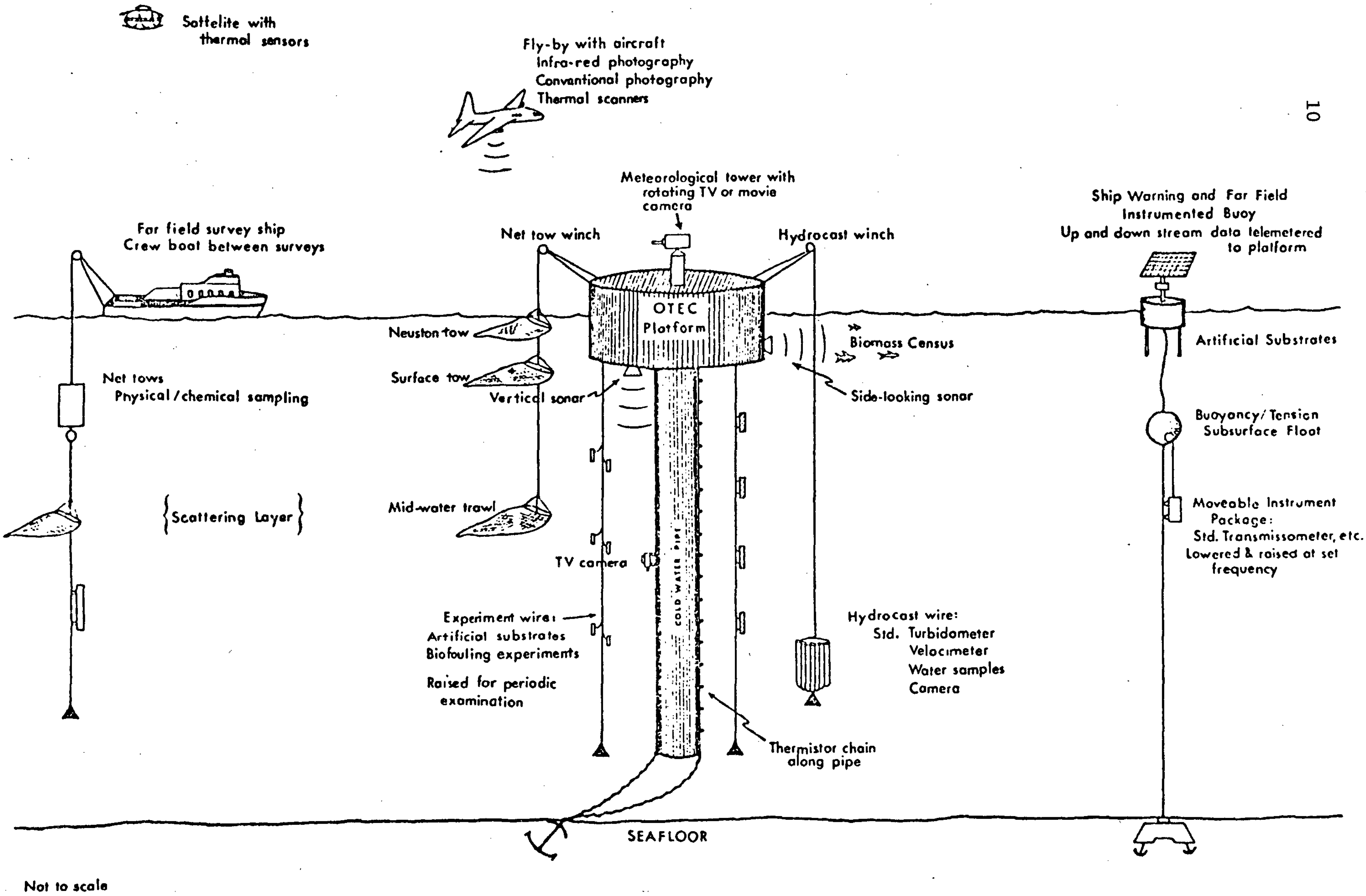


Figure 2-OTEC

Table 2

PROPOSED ECOLOGICAL MONITORING STRATEGIES

			Time Schedule
STEP I	-	PRE-OTEC site occupation studies; background sampling of significant ecological and chemical parameters in conjunction with a literature review to define pre-operational environmental conditions. Sampling from survey ships or from fixed moorings Sampling frequency bi-monthly initially for one year, further sampling frequency to be determined by experience	Initiated FY 78 in Hawaii, Puerto Rico, Gulf of Mexico, South Atlantic (contractor operated, LBL monitored)
STEP II	-	Non-interference with Platform Operations No permanent work space on platform Sampling equipment self-contained and transported to and from site Sampling frequency a function of operations schedule All analyses done on beach	Initiated FY 80 Platform First deployment OTEC-1
STEP III	-	Limited interference with platform operations Limited permanent work space on platform Sampling equipment and some analytical equipment on site Most analyses done on beach	Plan FY 79 RFP late FY 79 Operational FY 80 (Contractor operated, LBL monitored)
STEP IV	-	Limited interference with platform operations (Crane operations, etc.) Permanent work space in container/vans Power/water from platform but with backup systems	Plan FY 80 (Experience from Phase I and II) RFP FY 81 for additional OTEC-1 deployments

Table 2
(continued)

		Time Schedule
STEP IV - (continued)	<u>Operations Van</u> (sensor packages on buoy)	Operational FY 81
	A. Wet Lab - sample preparation - gross equipment repairs B. Dry Lab I - instruments/analyses/electronic repairs C. Dry Lab II - data reduction/storage/remote monitors	(first unit) Additional units as required
	<u>Storage Van</u> (not applicable to buoy)	
	A. Wet Storage - nets, over the side gear B. Dry Storage - equipment, paper C. Sample Storage - refrigerator	
	Real time operations with rotating permanent technicians Essentially all analyses and data processing done on site	

that the basic environmental conditions relating to OTEC are spatially homogeneous, although likely to vary seasonally. To characterize each subregion a reconnaissance benchmark is located. A benchmark is defined as a specific location, typical of a subregion, where serial data are taken and to which historical data may be referred. Because of the lack of serial, long term records of any kind in attractive thermal regions, we believe that the benchmark approach is more valuable in the long term than initiating broad regional surveys where variations in measurements may be attributed to site as well as time variability. Where substantial subregional variability is found, the benchmarks will be used as starting points for potential regional surveys. The intent of taking measurements at benchmarks is to provide data, at a specific location, which will form the basis, in conjunction with previously obtained data from the area, for defining longer term and more comprehensive environmental surveys required for the siting and permitting of OTEC plants in the designated thermal regions. Station operations at the reconnaissance benchmark sites are given in Tables 3 and 4. In addition to this station operation at each benchmark, a current meter array is deployed to complement current profiler runs during station operations. Satellite data, when available, is used to assist the interpretation of data from the arrays. Because of costs and reliability factors, measurements for the initial surveys is mainly from survey ships rather than from instrumented buoys. The survey ship occupies each benchmark site bi-monthly for a minimum of three days with augmented sampling every four months. Sampling at each station occupation is designed to give, at a minimum, day-night variations as well as bi-monthly variations for the biologically significant parameters. Parameters sampled bi-monthly are thought to have variations which may be detected at that frequency. Parameters sampled every four months are thought:

(1) to have less varation annually; or

(2) to have potential but unresolved significance to OTEC.

The augmented sampling every four months is also done to develop optimal measurement and sampling techniques for parameters which may become routine during future site occupations. Upon completion of the initial study (actually, during the surveys) the sampling frequencies and choice of parameters will be re-examined. Results from augmented samplings, from serial samplings and historical data reviews will be used to design subsequent site data collections.

MASTER PLAN - OUTLINE OF CRITICAL PATH

Given a candidate site or region, the following gives a proposed outline of the ideal progression of steps to be taken in the evaluation of the environmental concerns for that site or region. It is assumed that the primary selection of sites is a policy function of OTEC headquarters. The procedures presented here are designed to be applicable to any candidate site or region to insure the quality and uniformity of information with respect to scope and kind available to regulatory agencies, policy makers, engineers/designers, concerned citizens groups, etc. However, we realize that each site or region is to some degree unique with its own characteristics not found elsewhere. Accordingly, the suggestions here are to be considered only as a minimum; with any site or region specific information is to be included where applicable.

PHASE I - Pre Go-Ahead Decision

o LITERATURE SURVEY AND OTHER PREVIOUS WORK

Table 3

STATION OPERATION

PROFILER.	VERTICAL PROFILES OF HORIZONTAL CURRENTS
HYDROCAST.	DISCRETE SAMPLES AT DEPTH OF: A. Temperature B. Salinity C. Dissolved Oxygen D. Nutrients E. Phytoplankton
STD.	VERTICAL PROFILES OF SALINITY, TEMPERATURE
NET TOWS.	BIOLOGICAL SAMPLES
XBT.	VERTICAL PROFILES OF TEMPERATURE TO 750 M
CURRENT METER ARRAYS.	DISCRETE MEASUREMENTS OF HORIZONTAL WATER CURRENTS AT DEPTH
TRANSMISSOMETER.	VERTICAL PROFILES OF LIGHT TRANSMITTANCE

CLASS OF STATIONS

<u>PRIMARY</u>	<u>3-DAY DURATION</u>
Occupied in locations of prime OTEC interest - sampling frequency to ascertain diurnal changes	2 Deep Hydrocasts 2 Shallow Hydrocasts 2 Oblique Net Tows 4 Current Profilers 12 XBT 4 STD
<u>CURRENT PROFILER</u>	<u>2-1/2 HOUR DURATION</u>
Occupied to determine spatial variability of current regime	1 Current Profile

Table 4

ECOLOGICAL/CHEMICAL PARAMETERS
INITIAL ONE-YEAR BENCHMARK PROGRAM

PARAMETER	STATION OPERATION	STATION FREQUENCY *	SAMPLING FREQUENCY *
Temperature	hydrocast	bi-monthly	all hydrocasts
Temperature	STD,XBT	bi-monthly	4 STD, 12 XBT
Salinity	hydrocast	bi-monthly	all hydrocasts
Salinity	STD	bi-monthly	4 STD
Water Currents	current meter	continuous	one per 30 minutes
	profiler	bi-monthly	4
Light transmittance	transmissometer	bi-monthly	2 traces per cruise
Dissolved Oxygen	hydrocast	bi-monthly	2 casts
Orthophosphate	hydrocast	bi-monthly	2 casts
Total Phosphate	hydrocast	every 4 months	2 casts
Silicate	hydrocast	bi-monthly	2 casts
Nitrate	hydrocast	bi-monthly	2 casts
Ammonia	hydrocast	every 4 months	2 casts
Urea	hydrocast	every 4 months	2 casts
Total Nitrogen	hydrocast	every 4 months	2 casts
Alkalinity	hydrocast	yearly	2 casts
Trace Metals	hydrocast	yearly	1 cast
Chlorophyll/Phaeophytin	hydrocast	bi-monthly	2 shallow casts
ATP	hydrocast	every 4 months	2 shallow casts
Phytoplankton census	hydrocast	bi-monthly	1 shallow cast
C^{14} uptake	hydrocast	every 4 months	1 cast
POC	hydrocast	yearly	1 cast
DOC	hydrocast	yearly	1 cast
Zooplankton census	net tow	bi-monthly	6 tows

*May change based on experience at individual site for long-term monitoring program.

Published and unpublished literature, pertinent to the selected site or region, will be compiled and searched for data of potential interest to OTEC. Experts in the area will be identified. Agencies, institutions, schools, etc., with data bases, collections, etc., will be identified and contacted with the availability of their information ascertained.

o ORGANIZATION INTO A STANDARD FORMAT
All data obtained from Step I will be collated and displayed on a uniform base. This includes base maps of appropriate scale, uniform graphics and tabular material where appropriate. Such material and non-standard material such as photographics, keys to collections, etc., will be compiled into source volumes for the candidate area or region.

o COMPARISON WITH ACCEPTABILITY MATRIX
Information in the source volumes will be scrutinized parameter by parameter with respect to its validity, accuracy, and precision so generalities will be drawn from data of similar quality.

o CONSTRUCTION OF ADEQUACY MATRIX
Data of comparable quality will be examined as a function of quantity of measurement, frequency and time history of sampling by a panel of experts to determine for each critical area whether sufficient data exists for a preliminary decision on the acceptability of the site or region. In this step data gaps will be identified.

o PRELIMINARY DECISION
On site/region as a candidate for OTEC operations. Options: a) Definite no-- overriding negative factors; b) Qualified No-- negative factors present which may be mitigated by design strategies; c) Ambiguous-- potential negative factors or conflicting data which cannot be resolved by information to date; d) Neutral; e) Qualified Yes-- positive factors with ambiguous unknowns.

o POLICY DECISION
Yes/No on continuation of consideration of site/region as candidate for OTEC operations. If yes - proceed.

PHASE II - Pre-Operational

o INITIATE EIA/EIAS FOR SITE/REGION
Based on the current level of technological development of OTEC. Begin fulfilling the legal requirements for eventual permitting of the site.

o DESIGN CORRECTION STRATEGIES
Based on the adequacy matrix design a measurement and assessment program which eventually will provide information to reduce the level of uncertainty about site/region.

o DESIGN SERIAL PRE-PLANT MONITORING STRATEGIES
In conjunction with correction strategies, design a measurement and assessment program which will augment existing or begin serial data collections required to provide sufficient background information to access impact of any future OTEC operations at the site.

o INITIATE ONE YEAR PILOT PROGRAM

At site to ascertain environmental variability. As it is unlikely that sufficient data exists on annual and seasonal variability at any given site, the initial sampling frequencies must be estimated for most parameters. The intent of this program is to sample at high enough frequencies to justify the choices used in the long-term monitoring program. This program also will be used to test new or improved methods of sampling and to verify the utility of other parameters to access the environmental concerns.

o DESIGN LONG-TERM MONITORING/ASSESSMENT PROGRAM
As a result of the previous work and the one-year variability study, develop a long-range monitoring/assessment program which will lead to compliance with regulatory requirements and facilitate production of the appropriate EIA/EIS.

o DESIGN LONG-TERM MONITORING/ASSESSMENT PROGRAM FOR OTEC PLANT
This program is a companion to the one above except that it is designed to be operated from the actual plant. The primary purpose of this program is to monitor the intakes and outputs of the plant as well as the near-plant environmental conditions.

o POLICY DECISION
Request OTEC operations at site/region.

o OBTAIN COMMENCEMENT PERMITS
Submit final EIA/EIS for action by appropriate regulatory group.

AFTERWORD

As the initial OTEC test module OTEC-1 is not on station (projected for summer of 1980), it is too early to determine if the environmental strategies advocated here need to be augmented or modified greatly. Unquestionably strong interactions among environmental groups, regulatory agencies, designers and engineers, and DOE will be required to insure the success of the OTEC environmental program in attaining the goal of ecological compatability and economical viability for OTEC systems.

To insure continuity among stated DOE program positions and interim reports of this nature, portions of existing documents such as the OTEC Program Summary (1976 and 1977) and the OTEC Environmental Development Plan (1977 and 1978) have been quoted here exactly or with minor modifications.

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