

PROPOSED OTEC PUNTA TUNA PILOT PLANT

Jose Marina
Director of Planning and Engineering
Fernando Perez
Project Manager
Puerto Rico Electric Power Authority
San Juan, Puerto Rico

Abstract

A 40 megawatt OTEC pilot plant has been proposed in response to an invitation of U. S. Department of Energy (DOE). The proposal is submitted by Puerto Rico Electric Power Authority (PREPA) as prime contractor leading a team of highly qualified subcontractors. The team provides the services and capabilities required to take the plant from conceptual stage to operation, building up required information for plant scalability and commercialization. The concept proposed consists of a platform mounted on a jacket tower located about two miles south east of Punta Tuna, Puerto Rico, at a water depth of approximately 300 ft. Novel methods for laying and installing the cold water pipe are proposed. Equipment configuration to suit OTEC design requirements in accordance with safety requirements, in particular hurricane conditions, are proposed. Cleaning methods and maintenance approaches are discussed. The project is proposed to be a joint venture of DOE and PREPA which is offering a substantial cost share.

I. Introduction

The Puerto Rico Punta Tuna OTEC Pilot Plant offers, we believe, the best opportunity for a successful commercial Pilot Plant demonstration of Ocean Thermal Energy Conversion (OTEC) electric power generation. The Department of Energy Ocean Energy Systems Directorate, at the time of writing this paper, is planning to initiate a Six Phase Development Program leading to a commercial demonstration of a forty megawatt OTEC electric power plant using the free ocean thermal energy. The Commonwealth of Puerto Rico Electric Power Authority (PREPA) is a contender for one of the Phase I Conceptual Design contracts.

I assume you are acquainted with the OTEC power cycle and the Department of Energy OTEC Pilot Plant Program. This presentation focuses on an OTEC Pilot Plant Concept, its site and OTEC growth potential in Puerto Rico. The needs for low cost energy are well known. OTEC offers the largest continuous renewable sources of solar energy on our planet. The tropical oceans are the world's biggest solar thermal energy collectors and storers. The Punta Tuna OTEC Plant could be the forerunner of a vast new energy source.

II. Puerto Rico

The Commonwealth of Puerto Rico is probably well known to most of you. I will provide a brief comment on our island and its history that support this venture into this revolutionary new energy

source. The island of Puerto Rico was discovered by Christopher Columbus in November 1493 on his second voyage. We have repelled the English, Dutch and the French in our almost four hundred years of history. We rebelled against the Spanish before our acquisition by the United States. Today, we are the only commonwealth division of the United States. We have elected our governor since 1949. Puerto Rico is the most prosperous of the Caribbean Island Nations.

Our climate is that of a tropical island with moderate temperatures (77-85°F). The island typical of almost all the Caribbean Islands is of old volcanic origin with a central spine of 3500 - 4300 ft. high mountains and some flat land on the southwest and north coasts. The volcanic nature of the island offers very close to shore deep water at a number of points. These are ideal OTEC sites.

The people of Puerto Rico number some 3.5 million on 3,400 square miles or about 1,000 people per square mile. A very densely populated country. San Juan is our major city and population center. Other cities are Mayaguez, Ponce, Arecibo and Caguas. Figure 1 shows our island with respect to the mainland United States. Puerto Rico is located at approximately 18° north latitude and 66° west longitude some 800 miles east southeast of Miami and about 1200 miles southeast of New York. Figure 2 graphically shows the size of our island (some 35 by 100 miles) roughly a rectangle with the major dimension of an east-west axis. A 1,000 meter depth of water isobar is shown. The OTEC site is located on the southeast corner facing south into the Caribbean Sea.



Figure 1 Puerto Rico and the United States

A 40 MWE FLOATING OTEC PLANT AT PUNTA TUNA, PUERTO RICO

Benjamin W. Dambly, P.E.
Project Manager-Sea Solar Power, Inc.(SSPI)
York, Pennsylvania

Abstract

Congressional legislation has been enacted to help pave the way for the commercialization of Ocean Thermal Energy Conversion (OTEC). DOE has responded to this legislation with a program to provide conceptual plant designs leading to OTEC pilot plants. In response to the DOE program, the OSEA (Ocean Solar Energy Associates) consortium outlines here a plan to provide a 40 Mwe floating plant at Punta Tuna, Puerto Rico, with the primary objective of having this project acceptably represent the technical, financial, environmental, institutional, and commercial aspects of future, full scale designs.

Introduction

In September of 1980, the U. S. Department of Energy (DOE), in response to the mandates of Congressional Act 96-310, and as a continuing segment of its Ocean Systems Program, issued Program Opportunity Notice (PON) DE-PN01-80CS80000 for a development project leading to a closed-cycle ocean thermal energy conversion (OTEC) pilot plant. In response to that call, Ocean Solar Energy Associates (OSEA), a consortium of companies dedicated to the development of the OTEC concept, submitted a plan for design, construction, deployment, start-up, and operation of a 40 Mwe floating electric generating plant at Punta Tuna, Puerto Rico. This brief report will provide a description of that offering, and outline OSEA's proposed approach for making OTEC a successful reality within five years.

The OTEC Concept

Fig. 1 illustrates the basic concept for generating electricity from ocean thermal gradients utilizing a self-contained floating platform, much like a present-day semi-submersible oil drill rig. The warm ocean surface water is pumped through the system, where its heat vaporizes the working fluid. This vapor drives the turbine, producing power in the generator, and then is condensed by the colder water from the ocean depths. The power fluid is finally directed back to the evaporator to be re-used, and the water is returned to the ocean. This is fundamentally the application of an organic Rankine cycle to the task of low level heat recovery.

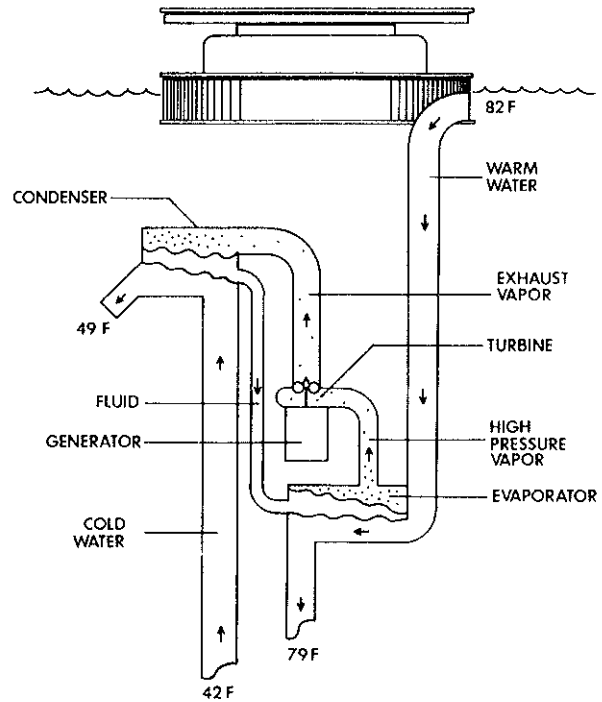


Fig. 1 - OTEC Closed Power Cycle

Puerto Rico As An OTEC Site

Fig. 2 provides a simple schematic illustration of the floating plant concept. The selection of Punta Tuna as the OSEA pilot plant site is a natural step in the evolution of an OTEC program which began in Puerto Rico as early as 1965, as a result of J. Hilbert Anderson's correspondence with Puerto Rican authorities during this period. At that time, representatives of the Governor's office and members of the Puerto Rico Water Resources Authority began a preliminary evaluation of this concept which subsequently led to studies by the University of Puerto Rico, and ultimately the inclusion of OTEC in the research programs begun when