Ocean Thermal Energy Conversion (OTEC) Technology

Ocean Thermal Energy Conversion (OTEC) is a technology for generating renewable energy that uses the temperature differential between the deep cold and relatively warmer surface waters of the ocean to generate baseload electricity. The technology is viable primarily in equatorial areas of the earth where the year round temperature differential between the deep cold and warm surface ocean waters is greater than 20 °C (36 °F). An OTEC facility continuously requires large volumes of both warm and cold water to generate electricity. A 100 megawatt (MW) OTEC facility would likely require 10-20 billion of gallons of water per day. There are several types of OTEC systems; this document describes the most likely initial commercial OTEC facility: an offshore, closed-cycle system.

Closed-Cycle OTEC Power System:

OTEC is a heat engine system with a heat source (i.e., warm water) and a heat sink (e.g., cold water). The warm water passes through a heat exchanger (i.e., evaporator) which is in contact with a closed loop of working fluid (likely ammonia). The warm water evaporates the working fluid into a vapor which expands and drives a turbine. The turbine, connected to a generator, is the source of mechanical energy. The generator converts the mechanical energy into electrical energy. After the vaporized working fluid passes through the turbine and generator it enters another heat exchanger (i.e., condenser) which is in contact with the cold water. The vaporized working fluid is condensed back into a liquid which is then pumped back into the evaporator to complete the cycle. Both the cooled warm water and the warmed cold water are discharged into the ocean after they have passed through the heat exchangers. Figure 1 is a schematic of the closed-cycle system.

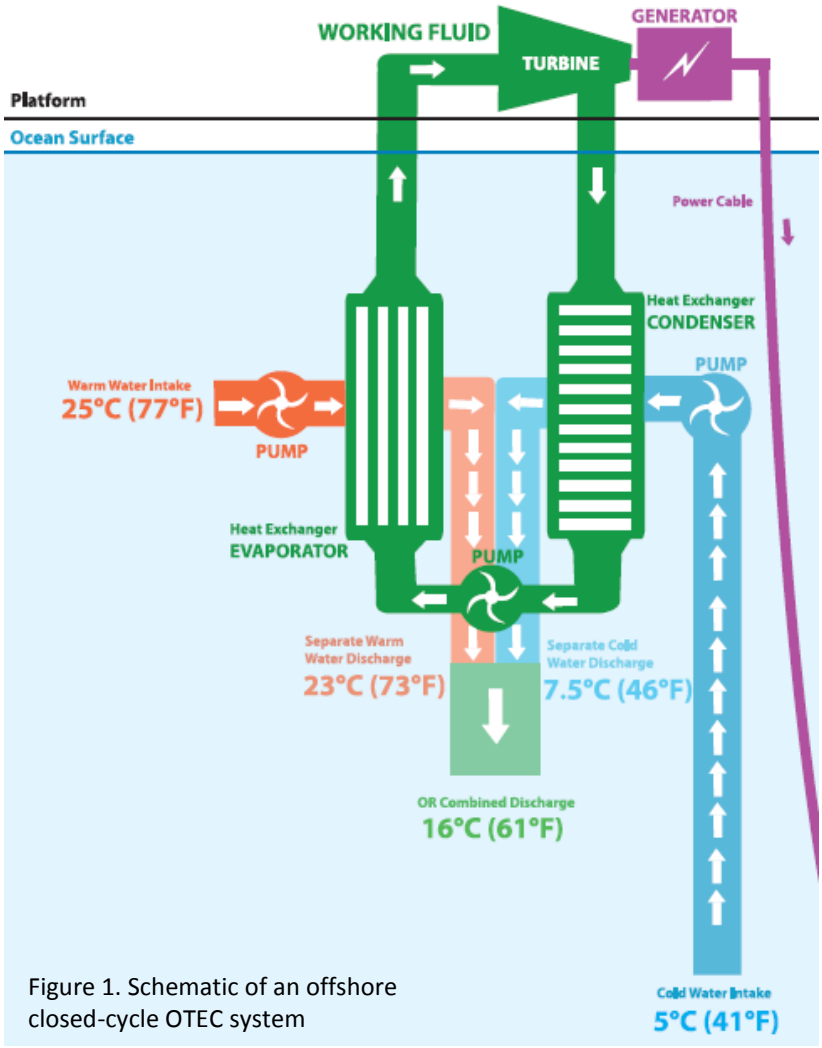

Figure 1. Schematic of an offshore closed-cycle OTEC system

Cold Water Pipe:

A unique feature of an OTEC facility is the cold water pipe. The pipe must be able to withstand the rigors of the marine environment in order remain attached the OTEC platform. In order to obtain the temperature differential required for the system (20 °C), the pipe must be able to withdraw cold water at a depth of approximately 3300 feet (1000 meters). To accommodate the large cold water flows, the size of the pipe for a 100 MW facility may be approximately 33 feet (10 meters) in diameter. The construction, deployment, and installation of the cold water pipe have remained an engineering challenge.

Other System Features:

A surface platform is an integral part of the facility which is necessary to house the equipment required for the OTEC system. A stationary OTEC platform would be held in place by mooring lines and anchors. An OTEC platform may be visible from the shoreline. A power cable lying upon or beneath the ocean bottom would connect the electricity from the off-shore facility to the electrical grid.

Other OTEC Products

OTEC technology has the potential to be integrated with other commercial systems (e.g., aquaculture and sea water air conditioning) and products (e.g., potable water, ammonia, and hydrogen).