OTC 20170

OTEC Commercialization Challenges

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This paper was prepared for presentation at the 2009 Offshore Technology Conference held in Houston, Texas, USA, 4–7 May 2009.

Abstract

An industry and university team is developing ocean thermal energy power plant designs to provide baseload, renewable electricity to commercial power grids and to Department of Defense base grids. This paper provides some general thoughts on OTEC commercialization challenges. A brief description of OTEC and a view of the market are provided. Based on two years of design efforts and market assessments, challenges in technology, economics, and risk are discussed. No technology barriers are evident at this time. OTEC can be affordable though much work remains to be done. Because OTEC has not been commercialized nor has been demonstrated by anything approaching megawatt scales, a megawatt scale pilot plant is necessary to validate performance and cost for subsequent availability of financing for commercial applications.

What is Ocean Thermal Energy Conversion?

Ocean Thermal Energy Conversion (OTEC) is the extraction of solar energy via a heat engine operating across the temperature difference between warm surface seawater and cold deep seawater. In the tropics, surface waters can be above 80°F. At ocean depths of 1,000 meters and more, water temperatures can be below 40°F. This temperature differential can be used in a heat engine to generate electricity. The thermodynamic Carnot efficiencies of small temperature differentials are very low. For a system operating between 80°F and 40°F the maximum theoretical efficiency is only 7.4% and real efficiencies will be less. Regardless, Carnot efficiency is not the true measure of OTEC feasibility since “fuel” is free. OTEC has been demonstrated as a technically feasible method of generating electricity. A number of different heat engine concepts exist. Most concepts use a Rankine cycle with a low boiling point working fluid. Refer to figure 1. Warm surface seawater is used to boil the working fluid in the evaporator. The vapor is then expanded through a turbine to drive a generator producing electric

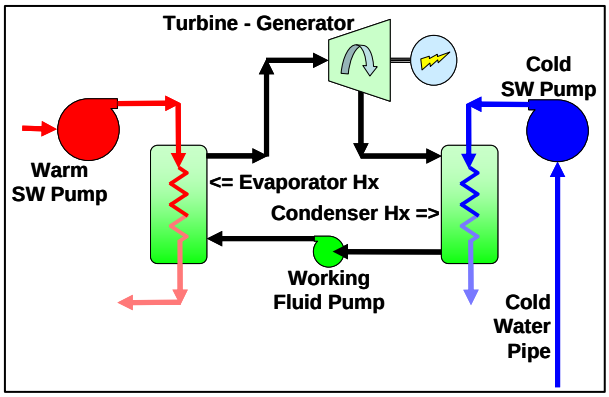

Figure 1 Rankine Cycle

power. The expanded vapor is converted back to a liquid in the condenser using cold deep seawater. The working fluid pump returns the liquid back to the evaporator to complete the cycle. Ammonia is one choice for an OTEC working fluid due to favorable thermal properties matching seawater temperature conditions. The cycle efficiency