Hybrid Cycle OTEC

Some marketing studies have suggested that OTEC systems that can provide both electricity and water may be able to penetrate the marketplace more readily than plants dedicated solely to power generation. Hybrid cycle OTEC was conceived as a response to these studies. Hybrid cycles combine the potable water production capabilities of open cycle OTEC with the potential for large electricity generation capacities offered by the closed cycle. Several hybrid cycle variants have been proposed. Typically, as in the Claude cycle, warm surface seawater is Sash evaporated in a partial vacuum.

This low pressure steam Sows into a heat exchanger where it is employed to vaporize a pressurized, low-boiling-point Suid such as ammonia. During this process, most of the steam condenses, yielding desalinated potable water. The ammonia vapor Sows through a simple closed-cycle power loop and is condensed using cold sea water. The uncondensed steam and other gases exiting the ammonia evaporator may be further cooled by heat transfer to either the liquid ammonia leaving the ammonia condenser or cold sea water. The noncondensables are then compressed and discharged to the atmosphere. Steam is used as an intermediary heat transfer medium between the warm sea water and the ammonia; consequently, the potential for biofouling in the ammonia evaporator is reduced signiRcantly. Another advantage of the hybrid cycle related to freshwater production is that condensation occurs at signiRcantly higher pressures than in an open cycle OTEC condenser, due to the elimination of the turbine from the steam Sow path.

Economics of OTEC

Studies conducted to date on the economic feasibility of OTEC systems suffer from the lack of reliable cost data. Commercialization of the technology is unlikely until a full-scale plant is constructed and operated continuously over an extended period to provide these data on capital and personnel and maintenance expenses.

Fresh Water

The condensate of the open and hybrid cycle OTEC systems is desalinated water, suitable for human consumption and agricultural uses. Analyses have suggested that Rrst-generation OTEC plants, in the 1}10MW range, would serve the utility power needs of rural PaciRc island communities.

Refrigeration and Air Conditioning

The cold, deep sea water can be used to maintain cold storage spaces, and to provide air conditioning. The Natural Energy Laboratory of Hawaii Authority (NELHA), which manages the site of Hawaii's OTEC experiments, has air-conditioned its buildings by passing the cold sea water through heat exchangers.

Mariculture

The cold deep ocean waters are rich in nutrients and low in pathogens, and therefore provide an excellent medium for the cultivation of marine organisms. The 322-acre NELHA facility has been the base for successful mariculture research and development enterprises.

Agriculture

An idea initially proposed by University of Hawaii researchers involves the use of cold sea water for agriculture. This involves burying an array of cold water pipes in the ground near to the surface to create cool weather growing conditions not found in tropical environments. In addition to cooling the soil, the system also drip irrigates the crop via condensation of moisture in the air on the cold water pipes. Demonstrations have determined that strawberries and other spring crops and Sowers can be grown throughout the year in the tropics using this method.

Energy Carriers

Although the most common scenario is for OTEC energy to be converted into electricity and delivered directly to consumers, energy storage has been considered as an alternative, particularly in applications involving Soating plants moored far offshore. Storage would also allow the export of OTEC energy to industrialized regions outside of the tropics. Longterm proposals have included the production of hydrogen gas via electrolysis, ammonia synthesis, and the development of shore-based mariculture

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Introduction

A power station is required to deliver power to a large number of consumers to meet their requirements. While designing and building a power station, efforts should be made to achieve overall economy so that the per unit cost of production is as low as possible.

This will enable the electric supply company to sell electrical energy at a profit and ensure reliable service. The problem of determining the cost of production of electrical energy is highly complex and poses a challenge to power engineers.

There are several factors which influence the production cost such as cost of land and equipment, depreciation of equipment, interest on capital investment etc.

Therefore, a careful study has to be made to calculate the cost of production. In this chapter, we shall focus our attention on the various aspects of economics of power generation.

Economics of Power Generation

The art of determining the per unit (i.e., one kWh) cost of production of electrical energy is known as economics of power generation. The economics of power generation has assumed a great importance in this fast developing

power plant engineering. A consumer will use electric power only if it is supplied at reasonable rate. Therefore, power engineers have to find convenient methods to produce electric power as cheap as possible so that consumers are tempted to use electrical methods. Before passing on to the subject further, it is desirable that the readers get themselves acquainted with the following terms much used in the economics of power generation : (i) Interest. The cost of use of money is known as interest. A power station is constructed by investing a huge capital. This money is generally borrowed from banks or other financial institutions and the supply company has to pay the annual interest on this amount. Even if company has spent out of its reserve funds, the interest must be still allowed for, since this amount could have earned interest if deposited in a bank. Therefore, while calculating the cost of production of electrical energy, the interest payable on the capital investment must be included. The rate of interest depends upon market position and other factors, and may vary from 4% to 8% per annum. (ii) Depreciation. The decrease in the value of the power plant equipment and building due to constant use is known as depreciation. If the power station equipment were to last for ever, then interest on the capital investment would have been the only charge to be made.