International Journal of Manufacturing & Industrial Engineering– IJMIE
Volume 1 : Issue 3 [ISSN 2374 – 1589]
Publication Date : 30 September, 2014

Cost Effectiveness of Efficiency Improvement in Various Inlet Air Cooling Systems

Kanyarat Tankong[1,2*], Athikom Bangviwat[1,2]
[1]The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, Bangkok, Thailand
[2] Center of Energy Technology and Environment, Ministry of Education, Thailand
*Corresponding author: kanyarat.t@egat.co.th

Abstract

Construction of new power plants and regulatory process for permit issuance take a long lead time and sometimes do not match the demand of electricity. Therefore, an efficiency improvement with minor modifications on existing power plants can be an attractive option for taking less time and investment. Power plants with higher efficiency consume less energy or gain more power output generation, and inevitably require more investment. Performance enhancement options must be economically retrofitted to increase power output and efficiency. In practice, cost effectiveness is used for the justification of the different modifications.

Combined cycle power plants are popular among the power generators in Thailand. Continuous improvements are implemented to compensate the degradation of the existing combined cycle plants and to maintain their capacities. Any improvement in the performance of a gas turbine would be most effective for the combined cycle power plant. A lower temperature of gas turbine air inlet increases power output of the system. There are different types of air inlet cooling systems, such as evaporative system, mechanical chiller system and absorption chiller system. The inlet temperature, parasitic load and flue gas temperature are the key factors contributing to the performance of the combined cycle plant.

Possible modifications and cost effectiveness for the air inlet cooling systems for a combined cycle power plant, consisting of 2x125.7 MW gas turbine generators and 1x109 MW steam turbine generator, are explored in the study. An evaporative cooling system, a mechanical chiller, and an absorption chiller require investments of US$ 149,105, US$ 16,303,226, and US$ 18,129,032, respectively, and the anticipated annual augmented energy are 20,779 MWh, 42,447 MWh, and 53,695 MWh, respectively. The cost-output ratio for the evaporative cooling system is as small as US$ 7.18 per MWh, while the cost-output ratios for the mechanical chiller, and the absorption chiller are US$ 384.09 per MWh and US$ 337.63 per MWh.

Keywords: Combined cycle power plant, Gas turbine air inlet cooling, Cost effectiveness