

Converting of Steam Power Plant to Combined Cycle by Boiler Repowering

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ABSTRACT

Nowadays, combined cycle power plants are well known for power generation with high efficiency and low emission. Converting of existing steam power plant to combined cycle is one of the best solutions for improvement of their efficiency and performance.

In this paper, three traditional methods of repowering are introduced and boiler repowering method is investigated thermodynamically. Then results of repowering of an existing steam power plant (Tabriz power plant, 2×368 MW) by boiler repowering method will be presented. Finally, the improvements in power and efficiency which can be obtained will be shown and compared with the current data of power plant.

INTRODUCTION

One of the main points in new power generation is energy usage optimization. On the other hand, there are lots of old and new steam power plants in country which are used with low thermal efficiency. Since there is continuous increment in power demand, using of these low-level efficiency power plants is essential. Environmental aspects and economical and political parameters limit the new power plant construction. So it seems good to repower existing power plant in order to improve their power and efficiency.

Combined cycle power plants which have both gas turbine and steam power plants thermodynamical advantages, are widely used nowadays. Modern combined cycle power plants efficiency is about 60 % which is considerably higher than conventional gas turbine and steam power plants. As a result, it can be seen that conversion of conventional steam power plants into combined cycle via

adding one (or more) gas turbine will improve power and efficiency with a low investment cost.

There are three methods of repowering which can be applied for steam power plants:[2]

- 1- Feed water heating repowering.[7]
- 2- Heat recovery steam generator repowering.[3,6]
- 3- Boiler repowering or hot windbox repowering.[2]

In the first method, which is suitable for new steam power plants, gas turbine exhaust is used for feed water heating. The main scheme is that some of steam turbine extractions are closed and relative heaters are bypassed. Then a new feed water flow line is designed and feed water is conducted to a specific heat exchanger for rising in its temperature with gas turbine flue gas energy and finally it is returned to main line.[7] The increased power in this method is about 30% and efficiency increment is low.(about 2 %)

In heat recovery steam generator repowering option, existing boiler is substituted by a new heat recovery steam generator and set of gas turbines. Increase in power is about 150-200 % and efficiency rise is about 30-40% respect to its old values. This method is suitable for old and retired steam power plants.

In the boiler repowering method, gas turbine exhaust flue gas which contains high percent of oxygen content, is used as combustion air and conducted into boiler windbox. It means that FD fan and air preheater will be replaced by gas turbine. Since the gas turbine exhaust temperature is higher than air temperature after air preheater, fuel consumption will fall. In this method, resulting power increase is about 40% and efficiency improves about 10-15%.

Boiler repowering option has the highest degree of technical complexity of all repowering options. The main

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