How to Select a Cooling Tower

Through the calculation of the mathematical model of the cooling tower thermal force, the design calculation parameters of the mechanical ventilation cooling tower and the natural ventilation cooling tower of the 2×460MW gas-fired combined steam cycle unit and the water conservancy calculation results of the circulating water system used in the two cooling tower forms are compared and analyzed. In terms of comprehensive economic comparison and dynamic economic analysis of the two cooling forms. The calculation results show that under the premise of meeting the cooling task, the mechanical ventilation cooling tower has more technical advantages considering the diversified characteristics of the cogeneration unit. In terms of dynamic economy, the total annual cost of the mechanical ventilation cooling tower is lower than that of the natural ventilation cooling tower. About 2.5%.

With the rapid development of China's natural gas industry, the natural gas cogeneration project has been widely promoted by its significant advantages in energy conservation and emission reduction and green environmental protection. Cooling towers are the key equipment for power plant cooling systems. The rational selection directly affects the economic cost and the diversification of unit operation. Therefore, the comparison and analysis of cooling tower selection is of great significance. In this paper, the technical analysis and economic analysis of the two types of cooling towers are carried out for the 2×460MW gas-fired combined cycle unit.

1 Thermal calculation mathematical model
The thermal calculation of the cooling tower adopts the relatively mature enthalpy difference method. The basic equations [1~4] are as follows:

Where: N is the cooling number; ?xv is the volumetric bulk density of the packing, kg/m3.h; V is the total volume of the packing, m3; Q is the amount of water treated by a single tower, m3/h; t1 is the inlet water temperature of the cooling tower, °C ;t2 is the cooling tower outlet water temperature, °C; i is the air ratio ? of the cooling tower watering device corresponding to a certain point, k J / kg; Cw is the specific heat of water, 4.184k J / kg. ° C; i" For the saturated air enthalpy corresponding to i, k J / kg; k is the heat coefficient taken away by the amount of evaporated water.

The water-filling filler used in the calculation is 1.25m domestically produced high-efficiency ramp wave. The thermal and resistance characteristic coefficients of the packing are: where q is the watering density, m3/m2.h; ? is the gas-water ratio.

2 Comparative analysis of calculation results
The technical parameters of the two cooling towers were compared and analyzed. In the table, Scheme 1 represents a mechanical ventilation cooling tower, and Scheme 2 represents a natural ventilation cooling tower. Naturally ventilated counterflow cooling tower with a watering area of 5,500 m2. The bottom diameter of the tower is DB=91.5m, the total height Hges=127.96m, the throat diameter DT=51.65m, the outlet diameter DA=55m, the inlet height HLE=8.15m, the top diameter of the packing is 84.48m, and the packing layer area is 5500m2.

3 Economic analysis

The circulating water volume of the two units in the hot and cold seasons was 59,646 m3/h and 44,542 m3/h, respectively. The number of circulating water pumps is 4 in the hot season, 4 in the cold season, and 3 in the cold season. The running time of the circulating water system is calculated according to the heat utilization year hours of 5665 hours, the economic service life is 20 years, the overhaul rate is calculated as 0.025, and the investment recovery rate is calculated as 0.08.

4 Conclusion

(1) From the technical comparison results, the 2×460MW gas-fired combined cycle unit adopts 12 mechanically-ventilated counterflow cooling towers and two conventional natural-ventilated counterflow cooling towers with a watering area of 5,500 m2. feasible. (2) Option 2 (Natural Tower Program) The operation is safe and stable, with less maintenance, but it occupies a large area. Scheme 1 (mechanical ventilation cooling tower scheme) has the advantages of small land occupation, flexible layout, low investment, short construction period, adjustable number of wind turbines according to different seasons, flexible start-stop, and low requirements on foundation bearing capacity. The mechanical ventilation cooling tower has certain technical advantages due to the limited conditions of the project site and the various modes of operation of the heating unit. (3) From the economic comparison results, the annual operating cost of the first option is 5,732,400 yuan higher than that of the second plan, but the initial investment of the first plan is lower than the plan two by about 50.18 million yuan; the dynamic economic analysis shows that the plan 1 is more than the plan two years. The cost value is as low as 713,000 yuan, accounting for about 2.5% of the total annual cost.