Energy Conservation and Consumption Reduction in the Operation of Power Plant Steam Turbines

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Abstract: As an important equipment of thermal power plant, steam turbine will consume a lot of energy in the process of operation. Therefore, reasonable measures should be taken to optimize it so as to ensure energy saving and reduce consumption while creating more economic benefits for enterprises and society. Therefore, it is necessary to ensure the effective and rational use of natural resources and better optimize the environment. If we can effectively save energy and reduce consumption in the operation of power plant steam turbine, it will be necessary to inevitably achieve better economic benefits. Therefore, it is required to carry out appropriate technical transformation of the steam turbine of the power station. This paper starts with the analysis of the possibility of energy saving and consumption reduction of power station steam turbines, and analyzes the related influencing factors of power turbine steam turbine energy consumption. Based on this, it explores the effective measures for power plant steam turbine energy saving and consumption reduction, aiming to promote the utilization of power station resources. The rate is increased to achieve low-consumption and high-yield production targets.

1. Introduction

At present. Global energy shortage. Energy saving and consumption reduction have become the main trend of power plants as an important basis for supporting economic development. In recent years, we are facing major challenges. Therefore. In order to seek the long-term development of power plants, major power stations have issued a series of improvement measures, introduced advanced technology and management mode, in order to occupy a larger market share [1]. Therefore, in order to improve its economic benefits, energy saving and consumption reduction of steam turbines should be taken as the main economic measures. That is to say, if we want to maximize economic benefits in the fierce market competition, we must vigorously implement energy-saving measures. Improving the economic benefits of power stations, energy conservation and consumption reduction is the main way for each power generation enterprise to improve economic efficiency, and it is also the fundamental strategy for each power station to win in today's cruel energy market competition [2]. In terms of energy-saving measures, power stations can start from many aspects, such as reducing transmission loss, saving water, saving electricity, and saving fuel in the production process to achieve energy saving. At present, the state proposes to save resources, protect the environment, develop a green economy, and take a path of sustainable development. As a high-energy-consuming enterprise, power stations are imperative for energy conservation and consumption reduction.

2. Possibility Analysis of Energy Saving and Consumption Reduction in Power Plant Steam Turbine Operation

From the economic point of view, the power plant is a profitable enterprise. In the transformation of steam turbine for energy saving and consumption reduction, the comparison of cost and benefit of energy saving is one of the key considerations of the power plant. Relevant practice has proved that the cost of adopting new steam turbines will be higher than the cost of technical transformation

of steam turbines in use, and the steam turbines after transformation will also reduce certain energy consumption [3]. According to the practical experience at home and abroad, the cost of purchasing new type steam turbines is far greater than the cost of technological transformation of existing steam turbines, and after the transformation of existing steam turbines, energy consumption will be reduced a lot. After decades of discussion. The retrofit technology for steam turbines has gradually matured. The modified steam turbine not only greatly improved the working efficiency. It also reduces energy consumption. From this point of view, this steam turbine retrofitting method can not only greatly reduce the cost of technical transformation of power stations, but also achieve energy saving and consumption reduction. From an economic point of view, this measure is feasible [4].

When the unit is running, the feed water temperature is affected by two factors, one is whether the fuel is fully combusted; the other is the amount of fuel [5]. The change of feed water temperature directly affects the change of boiler fuel quantity and affects boiler combustion. In order to ensure the high efficiency operation of the steam turbine, it is necessary to ensure that the water temperature is within a specified range. The water temperature meets the requirements to ensure safe operation, and the maintenance of the steam turbine is strengthened to ensure the normal operation of the steam turbine. In addition, focus on cleaning up to avoid blockage accidents [6]. After the energy-saving transformation of the steam turbine, it includes the modification of the main body steam seal, the modification of the regulating stage nozzle, the optimization of the cold end system, the optimization of the thermodynamic system, the optimization of the valve characteristics and the optimization of the fixed sliding curve, etc. Practice has proved that the energy conversion efficiency and thermal efficiency of steam turbines can be greatly improved by technical transformation of steam turbines, and their energy consumption can be effectively reduced. At the same time, the safety and stability of steam turbines after transformation will also be improved.

3. Factors Affecting Energy Consumption of Steam Turbine in Power Station

Steam turbine is a power generation equipment with very complex internal structure. In the process of operation, there are many factors affecting energy consumption, which can be divided into three categories: operation factor, shutdown factor and equipment factor. The main reason for the high energy consumption of steam turbine is that the nozzle chamber and outer cylinder of steam turbine are prone to deformation, and the two parts of diaphragm seal and shaft end seal are prone to leakage [7]. The unreasonable adjustment during the operation of the steam turbine makes the operation parameters of the steam turbine not conform to the actual load. The high temperature of vacuum pump leads to poor vacuum degree of condenser and poor thermal cycle effect of steam and water. When the unit load deviates from the rated load value, although other relevant operating parameters maintain the design value, but the steam flow will deviate from the design value, there will be throttling loss in the steam turbine regulating valve, and the corresponding turbine governing stage, high pressure cylinder and the last few stages will deviate from the design. Value, the economics of the steam turbine will be reduced [8]. As far as the actual situation of power plant steam turbine energy saving and consumption reduction is concerned, the main reason is to realize energy saving and consumption reduction by introducing advanced steam turbines, but the cost is far higher than the technical transformation cost of existing steam turbines. Not only must rely on comprehensive management methods to improve their energy efficiency, but also should analyze from a technical perspective, increase the intensity of technological innovation, improve their energy conversion efficiency from the source, and reduce energy consumption.

Wind and dust are the main factors affecting the steam turbine condenser. In the large dust and dust area, the condenser will run for a long time, and the warp will often accumulate a large amount of sand dust, which will increase the thermal resistance of the tube and affect its heat transfer. At the same time, affecting the smooth flow of the channel. The management level of the power station enterprise on the operation of the equipment has a great influence on the realization of the energy saving and consumption reduction of the steam turbine. The lower management level and the lack of attention to the technical transformation of the energy saving and consumption reduction of the operating equipment will cause the steam turbine to consume during the operation. More energy [9].

Steam turbines with higher operating frequencies such as start-up and shutdown, or too long warm-up time, will increase the energy consumption of the turbine. In the start-up of steam turbines, in order to ensure the temperature of steam pipes and cylinders to meet the start-up conditions, it is necessary to start the preheater. However, the long-term warming opportunities lead to a sharp increase in the heat consumption of steam turbines, while prolonging the time of grid connection, increasing the power consumption of unit start-up, and increasing the cost of power generation. Therefore, in order to really carry out the work of energy saving and consumption reduction, we should first make a comprehensive evaluation of the combustion system and find out the links that can take energy saving and consumption reduction measures. In addition, when the condensate water has more dissolved oxygen, it will also reduce its heat transfer efficiency, and erode the condensate pipeline, resulting in unbalanced flow of air-cooled condenser, which ultimately affects the operation of steam turbine and reduces the actual operation efficiency of steam turbine.

4. Measures for Energy Saving and Consumption Reduction in Steam Turbine Operation

4.1 Control of Water Temperature

Generally, the amount of boiler fuel and the degree of fuel combustion will affect the feed water temperature of the steam turbine. When the steam feed water temperature is low, the boiler will consume a lot of electricity, and at the same time increase the unit energy consumption of the steam turbine, resulting in a large loss of heat energy during smoke exhaustion, thereby significantly reducing Energy efficiency. We know that the temperature of the water in the boiler is determined by the amount of fuel and the degree of combustion. When the water temperature is low, the boiler unit consumes more coal and consumes more electricity, which will reduce the boiler operating efficiency. The feed water temperature should be specially controlled during the process of ensuring the input rate of the high-pressure heater. Let it be related to the start and stop of the turbine. During the operation of steam turbines, it is necessary to strictly follow the relevant regulations to control the start-up and stop of steam turbines, to ensure the water level stability, to help maintain the operation of steam turbines, to standardize the actual operation and operation, to clarify the existing silt, and to improve energy efficiency. When using high-level heater, it is necessary to ensure that the equipment works at the standard water level to ensure the heat supply, thus effectively avoiding the heat loss caused by improper operation. Secondly, the relevant staff are required to strengthen the maintenance operation of key devices in the equipment, and improve the efficiency of energy use through regular cleaning and cleaning. If the sealing of the high-pressure cylinder does not meet the standard, when the steam and water are heat exchanged, there will be a phenomenon of low efficiency, which will cause local steam short-circuit problem and severely limit the temperature of water supply.

4.2 Controlled Condenser

Based on the fact that the condenser will affect the running time of the steam turbine, the vacuum state of the condenser can be optimized at all times. This will help to improve the steam turbine kinetic energy, improve the efficiency of the steam turbine and prolong the service life of the steam turbine. When the steam turbine stops abnormally, it is necessary to ensure that the load rejection of the unit is carried out in accordance with reasonable parameters as far as possible. Ensuring that all systems and equipment will not be damaged by emergency shutdown plays an important role in ensuring machine life. Steam turbine operation can be appropriately adopted by certain slip and other modes. That is to say, the boiler water circulation can be maintained under the condition of low load. Ensure combustion stability. Therefore, a lower constant pressure level is used to adjust the high load condition with the help of nozzles to adjust. In the preheating process, energy consumption increases, and the cost of power generation increases. In order to strengthen the control of power generation cost in the start-up stage of steam turbine. By increasing the amount of steam, the speed of the warming machine is increased, and the start-up time is shortened, so that the difference in expansion can be controlled. In daily management, the condenser should be inspected

regularly to clean the scale and prevent the formation of scale, ensure the quality of the circulating water, and improve the heat exchange efficiency of the condenser. Keep the condensed water level at a reasonable position. If the condensed water level is too high, it will cause the condenser vacuum to drop. This is because the space is too small, resulting in a serious shortage of cooling area. Finally, in order to make the cooling area of the condensate large enough and the cooling time is long enough, attention should be paid to the observation of the water level of the condenser, which can effectively improve the working efficiency of the condenser.

4.3 Guarantee the Condenser of Steam Turbine in Vacuum State

In order to ensure the efficiency and capacity of steam turbines, reduce fuel consumption and improve the economic efficiency of steam turbines, the condenser of steam turbines should be kept in the optimal vacuum state. In order to improve the fuel efficiency and maintain the water circulation in the boiler during the operation of the steam turbine, the operation of the steam turbine can be promoted by means of stabilization, sliding and stabilization, so that under the condition of unsTable load, the unit can realize one-time frequency regulation. Regular inspection, maintenance, water exchange and other work of the water jet pool, water level in the water jet pool needs to be more sTable, water level is too high or too low, will affect its work efficiency. Ensure good sealing of steam turbine units. In order to avoid leakage of the condenser, the sealing of the unit should be inspected regularly or irregularly, and the equipment should be overhauled as much as possible to handle and check for leaks. If the steam pump of the unit needs to enter the condenser, the operation of the vacuum pumping system of the steam pump needs to be checked. If necessary, increase the shaft seal steam supply pressure and increase the output of the circulating water pump and vacuum pump. The normal condensate water level is maintained, the condenser water level is high, the condenser space is reduced, the cooling area is also reduced, and the condenser vacuum is lowered. Make sure there is enough cooling area to ensure that the condensate level is normal. Keep the unit in the best economical operation while ensuring its safety.

4.4 Control the Start-up, Operation and Shutdown of Steam Turbines

By scientifically and reasonably controlling the start-up, actual operation and shutdown of steam turbines, the working efficiency of steam turbines can be improved and the energy consumption of steam turbines can be reduced. When starting a steam turbine, it should follow a reasonable start-up curve. For example, the main steam pressure, main steam temperature and condenser vacuum during cold start-up of steam turbine have normal allowable range. Steam turbines are in normal shutdown state. Sliding parameters can be used to stop the machine properly. This can make full use of the remaining heat of the boiler to generate electricity. Reduce the temperature. Easy to repair related equipment. In this process, attention should be paid to the control of water temperature in the condenser. For the stopping of steam turbines, it is required only when it needs to be repaired. In addition, it is necessary to properly adjust the heater water level to ensure the feed water temperature and the investment rate, and to reduce the heater end difference, so that the various elements of the steam turbine can be appropriately adjusted under the condition of high load operation. During high-load operation, moderately and reasonably increase the main steam pressure and main steam temperature of the steam turbine, reasonably adjust the water level of the heater, reduce the heater end difference, and increase the feed water temperature. In this way, the boiler waste heat can be used to generate electricity, and the temperature of the boiler and steam turbine equipment can be reduced to facilitate the maintenance of the equipment. Steam turbines generally only stop when they need to be repaired. Therefore, in the shutdown phase of the turbine, it is necessary to carry out a comprehensive inspection of the key components, and at the same time set correct and scientific parameters to extend the service life of the turbine.

5. Conclusions

There are still many measures for energy saving and consumption reduction of power stations. This paper focuses on the analysis of energy saving and consumption reduction from the aspect of

operation adjustment. The means of energy conservation and consumption reduction should be diverse and not limited to operational adjustment. This paper starts with the adjustment measures of steam turbine operation and proposes corresponding energy saving measures. For steam turbines, energy saving measures are not limited to operating conditions, but can be summarized from other perspectives. In addition, the steam turbine can be finally energy-saving and reduced by effectively controlling multiple links in the operation of the steam turbine, combined with periodic inspection and technical transformation. In this way, it not only promotes the improvement of economic benefits of power plants, but also conforms to the strategic direction of national economic development, and makes power plants stand in an invincible position in competition with similar factories. Saving energy and reducing consumption is a long-term and arduous task. Only every staff member fully recognizes the importance of energy saving and consumption reduction in the process. And actively participate in the work. Only in this way can the cost of power station operation be reduced, thus bringing more economic benefits to enterprises.

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