Discussion on Flexibilization Reconstruction Plan of a 300MW Unit's Pulverizing System in Northeast China

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Abstract. In order to cope with the problem of renewable energy consumption, power plants in Northeast China need to carry out corresponding flexibility transformation to improve the peak peaking capacity of the unit. Among them, the transformation of the milling system is a key and difficult point in the whole process of transformation. This paper analyzes the possible problems caused by the transformation and proposes solutions by analyzing the 30% TRL milling system.

1. Introduction
On June 14, 2016, the National Energy Administration officially launched the demonstration project for flexibilization transformation demonstration. The Energy Bureau selected 16 typical projects in areas with more prominent renewable energy consumption problems to be piloted. In July 2016, six additional pilot projects were added. According to the relevant documents and other relevant documents required by the National Development and Reform Commission and the Energy Bureau, the “Special Action Measures for the Pilot Project of Renewable Energy Peaking Units”, the power plant needs to carry out corresponding flexibility transformation to improve the deep peaking capacity of the unit [1, 2].

The unit analyzed in this paper is the subcritical parameter of a 300MW steam turbine generator set designed and manufactured by Harbin Boiler Factory Co., Ltd., an intermediate reheating and natural circulation steam drum furnace. The balanced ventilation and four-corner tangential combustion method are adopted, and the designed fuel is lignite. Boiler model: HG-1035/17.5-HM35 type. The boiler adopts a full steel frame suspension structure and a tight-fitting arrangement. This paper analyzes and discusses the transformation plan of the milling system with 30% as the goal.

2. 30% TRL milling system transformation plan

2.1. Powder tube adjustable shrinkage hole replacement
Replace the 20 adjustable shrinkage holes corresponding to the five mills to improve the primary wind speed adjustable characteristics and alleviate the combustion deflection in the furnace [3, 4]. At the same time, the pulverized coal sampling is optimized for the location of the measuring hole, such as C grinding, the measuring hole is facing the tube, the insertion of the pulverized coal sampling gun is affected, and the measurement on the BCD milling tube should be carried out under the premise that the measuring hole is located on the straight pipe section. The holes are optimized for position.
2.2. Technical reform of cold air pipe branch of coal mill

Under the condition of 30% TRL, the total coal consumption is about 65t/h, and the three coal mills can operate normally with normal output. At this time, the grinding outlet temperature is as high as 90 °C (the test is stopped after less than 1 hour of operation during the test), the opening of the cold air baffle is full, the pulverized coal is in a flowing state in the pipeline, and the possibility of deflagration or ignition is not large, but it is reduced. The pulverized coal gas is hot. However, there is a possibility of detonation or internal partial ignition of the coal mill body, and technical transformation of the pipe diameter expansion of the cold air pipe branch of the coal mill may be considered. According to the actual operation of the site, the bypass cold air damper has been fully opened 100%, and the powder feeding temperature of the coal mill is still above 90 °C. If the wind pressure is reduced, the risk of the coal mill blocking will occur. The system was modified to solve the problem of powder feeding over-temperature, and the transformation plan was determined based on the principle of effective and concise. Through the analysis and calculation of the boiler flue gas system flow chart, the cold primary air duct installation map, and the hot primary air duct installation diagram, the transformation scheme is implemented to reduce the bypass cold primary wind resistance and increase the cold primary air share [5, 6].

The design of the air duct reconstruction plan is completed by the resistance calculation analysis, and the initial calculation data is selected according to the 30% load field operation data of the boiler. According to the hot primary air temperature, the cold air temperature, and the primary air temperature, it is estimated that the proportion of the cold primary air bypass is about 16%, then the ratio of the cold primary air bypass to the total air volume is about 6.4%. The air resistance calculation range is the cold primary air passage bypass, including: the primary fan outlet three-way outlet, the cold primary wind turbine tube with elbow (Φ720mm), the cold primary wind mill front distribution box (Φ820mm), cold The primary air distribution branch pipe includes an elbow (Φ377mm), a cold air branch pipe and a hot air branch pipe are assembled with a three-way and a damper.

According to the analysis of the above calculation results, the total resistance of the cold air duct is about 583 Pa, and the resistance is mainly concentrated in the distribution branch pipe and the introduction and take-out position. The location and analysis can be modified as follows:

At the primary fan outlet, the bypass cold air outlet lead-out position increases the diversion elbow to significantly reduce the lead-out resistance loss.

Although the bypass cold primary wind turbine tube (Φ720mm and Φ820mm) diameter expansion can reduce the system resistance, but the amount of change is large, and the resistance to the pipeline system is limited, so no modification is made.

The flow rate of the cold primary air branch pipe (Φ377mm) is obviously higher than that of the mother pipe. Although the length is short, the resistance loss accounts for more than half of the total loss, and the way of increasing the diameter can be obviously improved, which can be changed from Φ377mm to Φ426mm.

Adjusting the damper and the partition door in the fully open state has limited improvement on the resistance, and the investment cost is large. It is recommended not to change, and the interface is to be transitioned by the size of the head.

Similarly, the introduction of the duct requires an increase in the diversion elbow to reduce the total drag.

According to the above transformation plan, the system resistance coefficient decreases, the cold air bypass and the hot air passage resistance are rebalanced, the proportion of the cold primary air bypass increases, and the total system resistance decreases. The ratio of cold primary air bypass is about 20%, and the ratio of cold primary air bypass to total air volume is about 8%. After mixing, the inlet air temperature can be lowered by 12 °C to 262 °C.

The total resistance of the system is reduced to 523.3Pa, and the reduction in resistance is mainly reflected in the introduction, extraction, and branch pipe sections, while the resistance of the parent pipe is slightly increased due to the increase in air volume.

Through the analysis and calculation of the cold air bypass, a modification scheme for reducing the resistance is proposed. After the transformation, the system was reduced to 523.3Pa, and the proportion
of cold air bypass was increased to 20%. After mixing, the inlet air temperature dropped to 262 °C. In
turn, the wind temperature at the exit of the coal mill can be reduced by about 10 °C.

The primary air rate is 50%. The same result shows that the cold air bypass resistance is reduced to
778.6Pa and the cold air bypass ratio is increased to 22%. After mixing, the inlet air temperature dropped
to 260 °C. In turn, the outlet air temperature of the coal mill can be reduced by about 11 °C.

2.3. MPS200HP-II medium speed coal grinding mechanism powder system optimization scheme

First, the basis of transformation and key to transformation

1) Basis for transformation
   (1) The existing separator pulverized coal is difficult to adjust, and it is not possible to effectively
       adjust the fineness of pulverized coal according to the change of coal quality;
   (2) It is not conducive to the even distribution of coal powder;
   (3) The MPS200HP-II coal mill’s output optimization and transformation has mature technology and
       successful transformation cases.

2) Key to transformation
   (1) The fineness of pulverized coal and the uniformity of pulverized coal should be ensured after the
       transformation, and the dynamic separator can dynamically adjust the fineness of pulverized coal within
       a certain fineness range, and the uniformity of pulverized coal should be good;
   (2) The resistance of the dynamic separator does not increase, and the output of the existing milling
       system cannot be reduced. Under the same coal quality and the same fineness of the pulverized coal, the
       output of the coal mill after the transformation is improved compared with that before the transformation;
   (3) Under the same coal quality, the same fineness of pulverized coal, and the same coal mill output,
       the resistance of the coal mill separator after transformation is not increased before the transformation;
   (4) Separator dynamic and static blades, separator top cover, separator outlet pulverized coal pipe
       need anti-wear treatment;
   (5) The coal powder of the pulverized coal pipe at the outlet of the separator is well distributed, and
       the deviation of the powder volume of the powder tube is small;
   (6) The static housing of the separator and the dynamic part of the seal need to be careful to prevent
       leakage of powder;
   (7) It is necessary to pay attention to the seal of the gearbox housing to prevent leakage of gear
       lubricant;
   (8) According to the actual burning coal quality, select the appropriate speed of the dynamic separator,
       and select the size of the reducer according to the speed;
   (9) Pay attention to the seal of the dynamic separator bearing during design to prevent the entry of
       coal powder and the occurrence of shaft jam;
   (10) According to the actual coal quality, the appropriate rotor blade diameter, vane diameter, and
       separator cylinder size should be selected according to the actual coal quality. The spacing between the
       rotor blades should be suitable.

Second, the specific transformation plan

The transformation of the static separator into a dynamic separator and the simultaneous replacement
of the dynamic rotating air ring of the coal mill greatly improved the low-load stable combustion of the
unit, and modified three sets of C, D and E grinding. According to the situation on the spot and the
spatial distribution.

The original separator is removed, the main disassembly part is the connecting flange of the separator
and the casing, the connecting flange of the separator and the falling coal pipe and the powder
discharging pipe, the interface flange of the grinding roller sealing air pipe and the inert gas And the old
coal mill wind ring. Install the fresh air ring before installing the separator. The replacement dynamic
rotary separator is composed of a rotor, a stator, a driving device, etc., and its interface with the coal
mill has four parts of interfaces, which are respectively interface with the casing connection flange, and
the connection method of the coal drop pipe and the powder discharge pipe. Blue interface, interface
with the grinding roller sealing duct, and interface with explosion-proof steam.
In addition, the new separator adds variable frequency electrical devices. Because the device is designed and assembled as a whole, it is convenient to install on site. The entire installation and commissioning period is no more than 20 days.

Third, the expected effect after the dynamic rotary separator transformation
1) The air volume deviation of each powder outlet of each coal mill is not more than ± 5%, and the powder volume deviation is not more than ± 8%;
2) The output of the coal mill is increased by 3%-5%;
3) To achieve ultra-fine powder combustion, the pulverized coal particle size R90 is adjusted from 35% to 10-40% dynamically adjustable;
4) The coal powder uniformity index should be ≥ 1.1;
5) The dynamic separator blade life is not less than 40,000 hours;
6) The dynamic separator runs smoothly, and the bottom cover vibration (double amplitude) is less than 0.025mm;
7) The noise value at one meter from the dynamic separator housing is not more than 85dB (A).

3. Conclusion
The problems existing in the operation of the unit after the transformation are mainly as follows: 1. The deviation of the primary air-powder speed in the powder tube of the coal mill is large, the combustion deflection is present in the furnace, the left and right deviations of the main re-vapor temperature are large, and the smoke flow field distribution uniformity is poor. 2. When the three mills are running, when the load is as low as 30% TRL, the inlet cold air baffle is opened to 100%, but the mill separator outlet temperature is above 90 °C. The coal mill body has the safety of pulverized coal deflagration or ignition. Hidden dangers. The solution measures are: technical adjustment of thickening of the cold air pipe branch of the coal mill to reduce the cold air resistance and increase the proportion of cold air volume to reduce the grinding separator of the three grinding operations under the condition of 30% TRL. The temperature of the outlet.

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