Research on AGC control performance optimization and application of 135MW coal-fired unit

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Abstract. This paper studies the corresponding performance optimization of unit coordinated control system. Combined with the actual operation of the unit, targeted optimization strategies are formulated and implemented for the main parameters such as active power, main steam pressure, feed water flow, main steam temperature and furnace pressure. After long-term tracking of operation and repeated adjustment of relevant control parameters, a more reasonable optimization effect is finally obtained, and the regulation performance of the unit coordinated control system meets the AGC input conditions.

1. Introduction

A 135MW unit of Xinjiang Huadian was originally a pure condensing unit, and the heating transformation was carried out in 2009. At present, the AGC regulation performance of the unit can not meet the requirements of Xinjiang dispatching and is often assessed by the power grid. Therefore, through loop optimization, improve the regulation quality of the coordinated control system and MCS subsystems, so that the AGC regulation performance of the unit can meet the assessment standards of AGC by Xinjiang dispatching control center (response time < 60 seconds, lifting rate > 1.5% PE / min), and can operate in AGC mode for a long time, And verified by test.

2. Anzlysis

2.1 The coal type

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2.2 CCS parameters

The coordination control parameters do not match the current unit operation. Under the coordination mode, the boiler master controls the main steam pressure and the steam turbine master controls the unit load. The main control parameters of the steam turbine are poor and the load regulation is unstable. The main control parameters of the boiler are poor, the main steam pressure regulation is slow, the lifting load can not meet the dispatching demand, and the pressure deviation is large, which is easy to trigger the pressure pull back circuit, which is not conducive to the rapid load regulation.

2.3 Other automatic control parameters

Other automatic control system parameters cannot fully match the coordination effect. Such as water supply, primary air pressure control, air volume and oxygen content, coal, water and air cannot be added (reduced) quickly.

2.4 Equipment impact

If the load is increased rapidly, it is easy to cause overtemperature of boiler wall temperature.

2.5 Heating impact

With large heating units, the influence of heating and air extraction is not calculated in the coordinated control.

3. Optimization

3.1 parameter optimization

Optimize the static and dynamic parameters of boiler main control PID. See Table I~III for the comparison before and after parameter optimization.

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Table 1. Boiler main control PID parameters

Parameter	static			dynamic		
optimization	P1	I1	D1	P1	I1	D1
Before	0.6	250	0	0.3	350	0
After	0.8	210	0	0.3	320	0

Table 2. Boiler main control function

proportional variable parameter function (increase)								
Unit load X	0	80	90	100	110	120	130	135
coefficientY	0.9	0.9	0.9	0.9	0.9	0.9	1	1

Table 3. Boiler main control function

Integralvariable parameter function (increase)							
Unit load X	0	70	80	100	110	150	0
Coefficient Y	1	1	1	1	1.2	1.3	1

Optimize the main control PID parameters and dynamic parameters of the steam turbine. See Table IV and V for the comparison before and after parameter optimization.

Table 4. turbine main control PID parameters

Parameter	static			dynamic		
optimization	P1	I1	D1	P1	I1	D1
Before	0.4	15	0	0.4	15	0
After	0.45	30	0	0.45	18	0

Table 5. pressure pull back function

Integralvariable parameter function (increase)								
Unit load X	-10	-1.5	-1	-0.5	0.5	1	1.5	10
Coefficient Y	-0.9	-0.8	-0.7	0.0	0	0.7	0.8	0.9

The unit was originally a condensing gas generator unit. After heating transformation, the control performance of the unit changes. It needs to be optimized after heat supply accounting, which is divided into non heating sliding pressure curve optimization and heating sliding pressure curve optimization. Optimize the sliding pressure curve, change the input of the sliding pressure function from the main steam flow to the corresponding main steam pressure setting value under the comprehensive load command, set the third-order inertia link and output it as the final sliding pressure setting value after speed limit. See Table Ⅵ and Ⅶ below for the comparison before and after parameter optimization.

Table 6. Sliding pressure curve function (heating)

Before optimization						
Unit load X	0	70	90	100	115	150
Sliding pressure setting Y	8	9	10.8	12	13.2	13.5
Before optimization						
Unit load X	0	70	90	100	112	150
Sliding pressure setting Y	8	9	10.8	12	13.2	13.5

Table 7 Sliding pressure curve function (non-heating)

Before optimization						
Unit load X	0	70	90	100	115	150
Sliding pressure setting Y	8	9	10.8	12	13.2	13.5
After optimization						
Unit load X	0	70	90	100	115	150
Sliding pressure setting Y	8	9	10.8	12	13	13.2

3.2 Logical modification

(1) Modify the primary air pressure setting logic, optimize the primary air pressure setting curve corresponding to the coal volume command, and increase the manual correction and feedforward action correction.

(2) Modify the boiler main control feedforward, optimize the static feedforward function in the boiler main control feedforward, and add pressure deviation differential feedforward, pressure set value differential feedforward, dynamic load feedforward and desuperheating water action feedforward in the boiler main control feedforward loop; When the coal quantity of the coal feeder reaches the lower limit, the main control of the boiler will be locked and reduced. When the coal quantity of the coal feeder reaches the upper limit, the command of the boiler will be increased.The modification of boiler master feedforward logic mainly includes: Boiler master control: feedforward consists of four parts: load static feedforward (ff0), load dynamic feedforward , pressure deviation differential feedforward , pressure set value differential feedforward and desuperheating water feedforward .

(3) Increase the closed-loop control link of fuel master control, set the number of automatic coal feeders and coal feeding deviation, and correct the PID parameters.

(4) Increase the command of locking unit and steam turbine load with large main steam pressure deviation.

(5) Modify the unit instruction and add AGC allowable conditions and AGC switching logic.

Increase the function and screen for setting the upper limit of each coal feeder, and set the trigger logic for each coal feeder command to reach the upper and lower limits.

4. AGC load following test data

4.1 Analysis of AGC load following test data

At 17:26:38 on April 24, the load began to rise. The load change range was 76 MW ~ 101.5 MW, and the set rate was 2.1mw/min. At 17:39:18, the load change at this stage ended. The statistical data are shown in the table below.

Table 8. Dynamic deviation of various parameters of load rise and load response of unit

Adjust quality items	Adjust quality actual value	Adjust quality reference value（DL/657）	conclusion
Load variation	76→87.4→93.6→101.5MW	20MW	qualified
Load change rate	1.6%Pe/min	1.5%Pe/min	qualified
Load response delay	35s	< 60s	qualified
Main steam pressure	±0.6MPa	< ±0.4MPa	unqualified
Main steam temperature	AUTO：±12℃ MAN：±24℃	< ±10℃	unqualified
Drum water level	±27mm	< ±60mm	qualified
Furnace negative pressure	±152Pa	< ±200Pa	qualified

4.2 Response of AGC load reduction parameters

At 19:14:03 on April 24, the load was reduced. The load change interval was 132 MW ~ 99.3 MW, and the set rate was 2.1mw/min. At 19:30:51, the load change at this stage ended. The statistical data are shown in the table below.

Table 9. Dynamic deviation of various parameters of load reduction and load response of unit

Adjust quality items	Adjust quality actual value	Adjust quality reference value（DL/657）	conclusion
Load variation	132→122→113→99.3MW	20	qualified
Load change rate	1.6%Pe/min	1.5%Pe/min	qualified
Load response delay	38s	< 60s	qualified
Main steam pressure	±0.54MPa	< ±0.4MPa	unqualified
Main steam temperature	±28℃	< ±10℃	unqualified
Drum water level	±27mm	< ±40mm	qualified
Furnace negative pressure	±121Pa	< ±200Pa	qualified

4.3 Steady state deviation of unit

The statistical data of load deviation of the unit under stable working conditions under different loads are shown in the table below.

Table 10. Steady state deviation of unit

Load command	Load deviation	Adjust quality reference value	conclusion
134MW	±0.43MW	< 0.5%Pe	qualified
70MW	±0.35MW	< 0.5%Pe	qualified

4.4 AGC load following performance evaluation

After coordinated optimization of the unit, the unit was successfully put into the coordinated control system, and the application was transferred to AGC to carry out load following test. The load and main steam pressure of the unit were tracked well. The unit is capable of long-term stable operation in coordinated control mode and AGC mode.

5. Existing problems and suggestions

Due to the idle stroke (about 10%) of the air supply and liquid couple actuator, the air volume and oxygen control of the unit are still manually controlled. After the maintenance of the liquid couple actuator, put the air supply into automatic mode and optimize the oxygen tracking closed-loop control.

After optimizing the unit coordinated control system and main analog loop logic, the relevant parameters are optimized through variable load test, and the load following test is carried out under AGC working condition. The following conclusions are obtained: under variable load working condition, the unit variable load rate, load response time, drum water level The quality of furnace negative pressure regulation meets the requirements of DL / T 657-2015 code for acceptance test of analog control system in thermal power plant. During load change, the variation range of main steam pressure and main steam temperature is larger than the standard value, but it still meets the requirements of safe and stable operation and load change of the unit.

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