Research and Development of Condensate Water Fined Processing Control System Based on FCS

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Abstract: This paper briefly states the features and advantages of FCS (fieldbus control system). In view of condensate water fined processing system of domestic 600 MW supercritical coal-fired generating units, it designed and developed a FCS for entirely process control, designed computer monitoring software and organized network monitor the change of data. At the same time, making the simulation device of the system, the FCS control system scheme is implemented on this device. It is verified by practice that the system control technology is advanced, safe, reliable and operation well. It provides a complete project for automation technology upgrade program in power plant. In addition, this device can be used in the power industry technical personnel training and teaching of colleges and universities. It is worth promotion and reference.

Key words: FCS, sequential function chart, programmable control, monitoring.

1. Introduction

Process control system has gone through four generations: the base meter control system, electric unit combined analog control system, centralized control system and DCS (distributed control system). With the development of industrial intelligent devices, as well as the development of digital communication, the field bus technology gradually formed at the end of nineteen eighties in the world. A new distributed control system which takes the technology as the core—FCS (fieldbus control system) is known as the fifth generation control system. The system connected all the site meters, controllers and other intelligent to the same bus. It is a real-time network control system which uses open field bus control communication network, production site controllers and intelligent instrument equipment at the automation bottom being interconnected [1].

The FCS system is far less mature than the DCS system when it entered into China.

So far, FCS system is still mostly used in medium or

small engineering project. FCS structure should adopt the use of Fieldbus Technology in the field equipment layer, all the equipment control strategies in control system [2].

The field bus technology is also gradually integrated into the power industry. Along with the application of Fieldbus Technology in low voltage electrical apparatus, high voltage switchgear, low-voltage complete sets of equipment, its effect is more and more prominent. It is the key to realize the automation of electric power systems.

At present, there have been more mature fieldbus products and system used in power plant, substation automation, distribution automation, gained very high economic benefits and development prospects.

In the thermal power units, more and more, the field bus control system is used in pneumatic or electric control valve of non important regulating loop, switch type electric valve, 380 V and 6 kV motor, and factory electricity power system, the field bus control system is also used in water treatment system, ash and slag removal system, electricity dust removal system, desulfurization system and coal conveying system [3].

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2. Condensate Water Fined Processing Control Device

The “condensate water fined processing simulation control training device” belongs to the construction project of national key vocational colleges approved by Ministry of Education, and belongs to “project to improve the professional services industry development capability” supported by the central financial [4].

The training device takes the condensate water fined processing system of homemade 600 MW supercritical coal-fired generating units as the research object. The system physical model is established, and full automatic control system is realized.

Condensate fined processing system is arranged in thermal power plant of large capacity, high parameter. As condensate water is ultimately sent to the pipeline of power plant boiler heating surface, the water quality will directly affect the quality of the feedwater. In order to ensure safe and economic operation of the unit, to prevent the corrosion and fouling of heating surface and turbine, it is necessary to carry on the fine treatment of condensate, remove the metal corrosion products and impurities carried due to condenser leakage [5].

The training device designed consists of one pre-filter and two 100% high-speed mixed beds. Filter and the mixed beds are arranged in series.

Currently, in the domestic supercritical, ultra-supercritical units, all prefilters are tube type with filter element. During normal operation, condensate water passes through the condensate pump into the fine processing system.

Firstly, iron, copper and other metal in the thermal system, the residual welding slag in pipe, sediment and other mechanical impurities, and suspended matter, are removed by the filter effect. In addition, the resin operation period and service life is prolonged because of the larger size particle removal.

In the mixed bed, strong acid cation resin and strong alkali anion resin form the mixed resin layer. The resins are all homogeneous particle gel type. The main role is

to remove dissolved salts of condensate water (i.e., the various anion, cationic), also to remove the suspended solids and colloidal impurities leaking out from the filter.

Now, the condensate water conductivity is generally less than 0.2 ms/cm. Therefore, through the filtering and removal of salt function, the fine processing of condensate is achieved.

Prefilter system is provided with a 100% bypass. When the prefilter pressure drop expands over a certain value, it states that a large number of solids are intercepted. Then the prefilter quits out of operation, the condensate bypass passage. Filter will be backwashed by backwashing water.

Two mixed bed, one running, one backup, when the running bed is not qualified or pressure difference is too large, it will launch another mixed bed and recycling operation until the effluent is up to standard and passes into the system. At this time, the loose effectiveness mixed bed splits.

Mixed bed system equipped with a 100% automatic bypass. When the condensate water temperature over 55 °C or system pressure difference is greater than a certain value, the bypass valve will automatically open, the input and output water pipe valve of the mixed bed system will close.

The fine treatment system sets up a 100% bypass and isolation valve, automatic bypass valve equipped with a manual bypass valve for repairing. Design of three level bypass systems enhances the system operation flexibility, and is convenient for equipment failure treatment.

3. Control System Construction

3.1 Control System Structure

The condensate water fined processing control system structure is of the FCS classification control system based on profibus-DP (decentralized periphery) bus. PLC (programmable logic controller), DP remote IO (input/output) digital module and DP/PA (process automation) coupler are hanging in the bus. In addition,

another set of PC (personal computer) is set up. 5,611 communication cards and PLC configuration software STEP7 V5.4 and fieldbus instrument configuration software PDM (product data management) 6 are installed in the PC. The PC machine also communicates with Siemens PROFIBUS PA bus instrument and PLC through the bus.

System parameter signals are sent to the remote monitoring station through the optical fiber. The remote control center is the upper layer, operator and engineer stations are set [6].

Due to the optical fiber communication is of high reliability and high security, strong anti-interference ability, wide bandwidth and long transmission distance and so on, this system makes up a ring network by using optical fiber module, industrial Ethernet switch EKI7659C and fiber. The production site and remote

monitoring center are linked, completing production equipment monitoring, control and operation management (Fig. 1).

System control cabinet adopts a standard industrial control cabinet, with a big power fan on the top, a lower waterproof air inlet groove, and high strength transparent glass in front. One can watch the entire cabinet instrument operation without opening the case. The whole cabinet body is of plastic coating structure, protecting against electric shock. In addition, the grounding device is set.

In the control cabinet, variety of standard parts and control instrument module are fixed in the front panel. The three-phase line four (~380 V, ~220 V) single-phase power is supplied for, controlled by the four phase three wire air switch. Leakage protection air switch is set, the safety compliance with international standards.

MIS—management information system; PM—power module; DI—digital input; DO—digital output; AI—analogue input; CP—communication processor.

Fig. 1 Control system structure diagram.

3.2 Control Strategy

In consideration of water treatment system is a typical sequence control system, this control strategy implementation method is to determine the status of each equipment and operation sequence and shift condition, draw the SFC (sequential function chart) and programming.

The SFC programming language makes the program structure clear, easy to read and maintain, greatly reduces the programming workload, and shortens the programming and debugging time. The system main SFC is shown in Fig. 2.

3.3 Program Organization

Then used PLC configuration software STEP7 V5.4 to program, program block is as shown in Table 1 [6].

The OB (organization block)1 block, is the main program processing user's communication, and realizes the input and output. But the cycle is not fixed, and the priority is relatively lower. But the communication processing configuration monitoring is very timely, so it is called FC (function)5 block, avoiding the contradiction problem that the monitoring center requires the input of system, while the FC5 block asking to withdraw [7].

Fig. 2 Main SFC of sequence start.

Table 1 Program block list.

Block	Function	Description
OB1	Execution as soon as possible	The main program call FC5
FC1	Overall operation	Monitoring filter, mixed A, B state
FC2	Pre filter operation	Including the initialization, splitting and backwash
FC3	Mixed-bed A operation	Including the initialization, splitting and backwash
FC4	Mixed-bed B operation	Including the initialization, splitting and backwash
FC5	System operation judgment	Determine the system input allowable conditions

Fig. 3 Real-time monitoring screen.

The I/O analog module needs quantity conversion, using the SCALE function provided by FC105 system.

4. Monitoring Screen Configuration

Kingview software is of global industry supervisory control. It is suitable for production and operation management and fault diagnosis of single equipment, and development of large centralized monitoring and management system. This system produced

monitor screen with Kingview software. OPC (object linking and embedding for process control) connection is established between the Kingview software and the instrument [8]. The supervisory screen is shown in Fig. 3.

5. Conclusions

“Condensate fined processing control simulation training device” is a new practical device independent

research and development.

It can not only be used in various schools and universities for automation course teaching and training, but also provides a detailed and comprehensive scheme for power plant to upgrade automation technology and level. The device has been put into the teaching operation, and has good effect, worthy of promotion.

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