Control system design of the pumping station

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Abstract. This paper describes the design process of the pump station control system. Aiming at the general characteristics of the operation of the pumping station's automatic control system, an application program using the ABB AC500 series programmable controller in the pumping station monitoring system was proposed. The cost of scheme is low and the management, maintenance and operation is simple. As the engineering practice shows, using ABB AC500 PLC to form project can get high reliability, high performance and high performance-price ratio etc., and has good economic benefit. And PC interface is made with the WINCCV6 of Siemens Company. The excellent openness of WINCC makes it particularly outstanding in distributed system. In PC dynamic display design compares two different methods to make dynamic display effect to achieve the best.

Key words: Plc, Winch, Opt, Abby, Ac500, Siemens.

1. Introduction
With the rapid development of science and technology, the "centralized management, decentralized control" model of the control system has become a new demand in the field of automation and control. This requires us to establish an advanced, reliable, efficient and easy to further expand the set of process control, monitoring and computer scheduling management in one and have a good open monitoring system to complete the entire process and all production equipment monitoring. Pumping station control is just like this.

The use of a collection and distribution system for the control of multiple pumps and related equipment can greatly increase the working efficiency of the staff. Our task is to set up a collection and distribution system for pump station control to efficiently control the pumping station equipment and monitor and protect it in real time.

2. Process Requirements Of The Control System
Based on the "centralized management, decentralized control" model, in the field control room, PLC remote monitoring of the pump station's high and low voltage distribution cabinets, electrical cabinets.
The pump is required to have temperature protection. When the high temperature limit is reached, the motor must be stopped. It has low water level protection, high water level alarm and continuous water level measurement function during pump startup and operation.

The water pump control system is divided into electric cabinet control, communication control, water level temperature control, and monitoring feedback control.

When the water level of the suction tank is too low, in order to prevent the pump motor from idling, the static pump should be operated; when the pressure level of the pressure tank is too high, there should be an alarm; when the temperature of the main pressure change is too high, there should be an alarm. The electrical cabinet control includes the electrical cabinet control system; the communication control system; the water level treatment control system; the temperature treatment control system; Sound and light alarm control system.

3. System Hardware Design
A: Hardware Devices
   Control equipment: primary power receiving cabinet, secondary power receiving cabinet, seven motors, main transformer, AC500 PLC.
   One power-receiving cabinet: equivalent to one switch, controlling the main transformer's on and off states.
   Secondary receiving cabinet: Equivalent to a switch to control the opening and closing status of the following circuit.
   Main Transformer: The 10 KV voltage received from the wire is converted to 6 KV for later use.
Seven electric cabinets: Control the opening and closing of seven pump motors, measure the voltage, current, and active/reactive power. Send these measured values to the PLC via MODBUS communication.

Seven Motor: In normal operation, the water in the suction tank is pumped into the pressure tank.

B: Other operating equipment

Computer (IPC)

UPS (Uninterrupted Power Supply)

Water Level Meter Three: JYB-K0-LAG 5 Meter Range 10 Meter Cable

PT100 two models: WZP-298 (12mm*150) and WZP-296 (10mm*30)

UPS is the English abbreviation of uninterruptible power system. It is an important external device that can provide continuous, stable and uninterrupted power supply. In this pump control system, the main role is: When suddenly encountered power failure, UPS can also provide computer and PLC cabinet power supply for about 1 hour, to facilitate the user to save information in a timely manner to prevent sudden power failure to damage the computer hardware.

The main transformer has Pt100 thermal resistance, which is converted into a 4~20mA current signal through the signal converter and sent to the AI module of the PLC. When the temperature of the main transformer is too high, the primary power receiving cabinet is circuited.

PLC selection and hardware design

The selection of hardware equipment was based on the requirements of the control process, the amount of data processed by the program, and the communication requirements. At the same time, the AC500 series PM581-ETH PLC of ABB was selected in consideration of the cost. Because the pump control system program has relatively little processing data and ABB's automation products have high performance, high flexibility, and high availability, the pump control system can meet the conditions required for program operation. In the control system of the pump station, the DC522 module is selected for the digital input/output module, and there are 16 24 V DC digital inputs/outputs for the group (2.0-2.7 and 4.0-4.7). The analogy input module selects AI523 and the two groups have 16 programmable analogy inputs (1.0-2.7 and 3.0-4.7).

4. System Software Design

The software design of this system includes PLC programming and HMI PC programming, ABB programming software Co-De-Sys V2.3 adopted by PLC, and WINCC V6 configuration software used by HMI.

PLC control system programming

1. The main program consists of electric cabinet control, communication control, water level processing, and temperature processing, sound and light alarm.

The electrical cabinet control includes the main program of the electrical cabinet control group program, out of control detection, and excitation detection. The control of the motor cabinet must be closed at one power receiving cabinet and the second power receiving cabinet. The pump has no high temperature alarm and runs out of control. The water level of the suction tank is not lower than the lower limit. The motor cabinet can only be controlled by the upper computer. Any item is not satisfied. Sub-gate treatment. Out of control detection is that the PLC did not perform the PLC sent the command after 2 second and reported an out-of-control failure. Excitation detection is when the motor is not energized after the normal closing of the motor, an excitation fault is sent.

2. There are two types of communication objects in the communication section. One is to read the pump temperature, and the other is to read the measured value of the comprehensive protector. The two types of communication methods are the same, but the number of read measurement values is not the same, and COM1 and COM2 ports are used for communication respectively. The communication part is executed once every second. After the communication is completed, the measured value is transferred to the address specified in the PLC for display on the upper computer and PLC processing.
3. The water level treatment is that the water level measurement value is directly read by the AI module and compared with the set value of the host computer. If the limit value is exceeded, an alarm signal is sent out.

4. Temperature treatment refers to the temperature of the water pump. There are 16 pump temperature values. The maximum value is first determined, then the maximum value is compared with the corresponding upper limit. If the upper limit is exceeded, an alarm signal is sent out.

5. Sound and light alarm means that if there is any fault, the integrated fault will be set. If the bell is not muted, sound and light alarm will be performed. When all the faults are cleared, 0 is set and the bell is muted.

HMI software system design
1. HMI programming
The upper computer uses Siemens WINCC V6 configuration software to produce. HMI is the abbreviation of Human Machine Interface, also called human-machine interface. WINCC is used to visualize the process and develop a graphical user interface for the operator. Open the SIMATIC WINCC click the Graphics Designer to create the new screen.

Specific functions as follows:
- Monitor the motor's current, voltage, power, and primary current, voltage, power, etc.
- Controls the motor's split/closing, primary/secondary panel power transmission.
- Real-time display of motor temperature point and transformer temperature, real-time alarm.
- Real-time display of the actual value of the 3 water level meters, real-time alarm.

2. PC and PLC OPC settings
The full name of OPC is OLE for Process Control, and its appearance has bridged the gap between Windows-based applications and on-site process control applications. Through DCOM technology and OPC standards, it is entirely possible to create an open, interoperable control system software, to achieve very important communication, OPC communication between the host computer interface and the PLC, the information inside the PLC can be completed after the communication Display on the interface, and reflect the operation on the interface to the PLC.

Open ABB OPC CONFIG and check PULIC Group for set the OPC server. Then click on server and right click on Append PLC. Click the Edit button on the right to set the communication parameters. The settings are the same as those in the PLC programming software.

Open Co-De-Sys. OPC.02 Press "Browse Server" for set the OPC in the PC, then select the desired read-write PLC variable. After selecting the variable, add the prefix and suffix for the variable, and select Add Location to add it. Open "Variable Manager->OPC->OPC Groups->CoDeSys_opc_02". The upper computer can read and write the variables in the PLC through the OPC server. Then we will assign these variables to the corresponding object in the upper computer.

5. Conclusion
With the rapid development of control technology, the field of automatic control requires the control system to be safer, more efficient, and more humane. This article takes the pump station control system as an example to introduce the design and implementation process of the distribution system. The system host computer development uses the world's most open PC development software WINCC. The "centralized management, decentralized control" model of this system has greatly improved the efficiency of the operator. The operator can monitor and control multiple devices in real time, which not only enables the device to operate more safely, but also greatly extends the life of the device.

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