Fire protection system design for thermal power plants

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ABSTRACT

In recent years, with the high level of China's market economy, the use of electricity resources is increasing, and the scale of thermal power plants is expanding, resulting in an increase in fire hazards. Therefore, thermal power plants are required to improve the design level in the design of fire protection system to ensure the design standardization. This paper provides a detailed analysis of the design of fire protection systems in thermal power plants, hoping to provide some help for the improvement of fire protection systems in thermal power plants in China.

Keywords: Thermal power , fire protection system, power plants

1. INTRODUCTION

1.1 Project introduction

(1) Project name: Huaneng Dalian Second Thermal Power Plant "on the big pressure small" new construction project.

(2) Project location: Ganjingzi District, Dalian City, east of Zhonghua Road, east of Daqi Dajiang, most of the land is the former Five23 plant area, part of the reclaimed area.

(3) Project scale: planning capacity of 2×50MW steam pumping back press + 2×350MW supercritical coal-fired units.If the paper does not have the margins shown in Table 1, it will not upload properly.

2. FIRE-FIGHTING MEASURES FOR EACH SYSTEM OF THE POWER PLANT

2.1 Fire-fighting measures of coal transportation system

The main objects of fire-fighting of coal transportation system are: closed coal yard, coal unloading equipment, coal transfer bridge, transfer station, belt layer between coal bunkers of main plant, etc.

Fire detection system is set up in coal transport buildings such as coal yard, coal transfer bridge, transfer station and belt layer between coal bunkers of main plant, and the distance between the temperature-sensitive cable setting height of coal transport system and coal transport belt should not be too high to meet the requirements of relevant specifications. Indoor fire hydrant fire extinguishing system is installed in coal transmission buildings such as coal yard, transfer station and belt layer between coal bunkers of main plant, automatic sprinkler fire extinguishing system is installed in coal transmission bridges, and water curtain fire separation facilities are installed at the connection of coal transmission bridges with transfer station and main plant. Mobile building fire extinguishers are installed in all coal transmission buildings[1-3].

Ventilation and dust removal devices are set up at the transfer station of the coal transportation system. The fire detectors and related connections in the fire alarm area of the coal transportation system should be waterproof type. Automatic sprinkler system is installed in the dust removal device of the coal transportation system of this project.

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2.2 Fire-fighting measures for the combustion system

The main fire fighting scope of the combustion system is coal hopper, boiler burner area, coal mill and lubricating oil tank, air preheater. Fire detection is set in the above-mentioned areas, and the coal hopper adopts low-pressure carbon dioxide fire extinguishing system; water spray fire extinguishing system is set at the boiler body burner area and coal mill lubricating oil tank, mobile foam fire extinguisher is set at the burner platform, and indoor fire hydrant is set at the boiler operating platform to extinguish fire manually[4-6].

2.3 Oil system fire-fighting measures

The fire protection measures of the oil system refer to the fire protection measures of the steam engine lubricating oil system. The steam engine lubricating oil system is generally arranged in the area with more high-temperature pipes, and in order to prevent the pressure oil from leaking out, the project adopts a set of oil pipeline. The higher pressure oil is in the inner pipe and the low pressure return oil is in the outer pipe. Even if the high pressure oil leaks, it only flows into the low pressure oil pipe, so it does not leak out, and the whole set of oil pipeline is welded, with very few flange interfaces, and the flange is selected by raising the working pressure by one level, so there is very little chance for the oil to leak out. The oil system has an accident oil pool outside the main plant, and when there is a fire, the oil can be manually discharged to the accident oil pool[7].

In the steam engine lubricating oil tank, net oil tank and dirty oil tank, hydrogen sealing oil device, oil pipeline under the steam engine running layer and middle layer, feed pump oil tank, etc., fire monitoring is installed and water spray fire extinguishing system and fire hydrant equipped with spray water gun are set to extinguish the fire manually.

2.4 Fire-fighting measures for electrical equipment

2.4.1 Transformer fire fighting

The transformer is equipped with accident oil storage pool and oil discharge facilities. When the oil is discharged in case of fire accident, the transformer oil is first discharged into the lower oil storage pit, and then discharged into the accident oil pool through the accident oil discharge pipe.

The main transformer and high-voltage plant backup transformer of this project are equipped with fire detection system and water spray fire extinguishing system.

2.4.2 Cable fire prevention

In order to prevent the spread of cable fire, flame retardant cables are used for control cables and power cables in this project, and the holes through which all cables pass are sealed tightly with flame retardant materials. Important circuits such as fire-fighting systems, control alarms, non-stop power supply and other power and control cables use fire-resistant cables, and cable ditches, roads, shafts and cable holes through the floor, wall holes and distribution panels, using cable fireproofing paint, blocking material sealing and other measures. Each building cable exit with blocking partition wall[8].

2.4.3 Electrical fire monitoring system

The electrical fire monitoring system can be used in places with electrical fire hazards. The hydrogen supply station in the power plant is a building with fire hazard class A. An electrical fire monitoring system should be set up, and a residual current type electrical fire monitoring detector should be installed in the 380V distribution panel of the hydrogen supply station. Temperature measuring type electrical fire monitoring detectors can be set in the medium voltage switchgear of the whole plant[9].

The alarm and fault information of the electrical fire monitor can be displayed on the fire alarm host in the central control room.

2.5 Fire protection measures for other buildings

Diesel generator room and diesel engine fire pump are equipped with fire detection system and water spray fire extinguishing system. The electronic equipment room and relay room of the electric control building, the cable mezzanine and distribution room of the steam engine room, and the relay room, cable mezzanine, communication room and distribution room of the GIS building adopt the full flooding IG-541 gas fire extinguishing system[10-12].

3. FIRE-FIGHTING WATER SUPPLY AND FIRE-FIGHTING FACILITIES CONFIGURATION

3.1 Fire-fighting water supply system

The fire-fighting water supply system of this project consists of fire-fighting pool, fire-fighting pressure stabilizing device, fire-fighting water pump and fire-fighting water supply network, mainly for indoor and outdoor fire hydrants, automatic sprinkler facilities, water spray fire-fighting facilities, tank foam fire-fighting facilities and cooling sprinkler facilities and other fire-fighting facilities.

The fire pump equipment is installed in the integrated pump room. The outdoor circular fire fighting water network is divided into several independent sections with valves, and the number of outdoor fire hydrants controlled by each section does not exceed 5. In order to prevent freezing, the outdoor fire hydrants are all underground fire hydrants with permanent and obvious signs on the ground.

3.2 Fire-fighting measures for the combustion system

Fire-fighting water volume is 147.5L/s according to the maximum fire-fighting water volume in case of fire (main plant fire-fighting requirements), and the fire-fighting water pressure ensures the water pressure required for fire hydrants and automatic sprinkler equipment at the most unfavorable point. The maximum water head required for fire-fighting water supply is 109m water column (indoor coal storage yard fire-fighting gun). This section provides some data, as shown in Table 1 and Table 2.

Table 1. Some of the buildings in the power plant need pressure for fire water supply

Serial number	**Water head required for fire fighting facilities (m water column)**	**Main plant area**		
		Boiler burners Platform of each level	**Main Plant Water curtain**	**Transformer Water spray**
1	The highest point of the building or indoor most unfavorable point fire extinguishing device (m)	Platform 24.9	44	8
2	Minimum water level of fire fighting water source (m)	-4.00	-4.00	-4.00
3	Fixed water jet requires water head (m water column)		10	40
4	Pipe network head loss (m water column)	25	30	30
5	Total (head required) (m water column)	73.3	88	82.5

Table 2. Some of the buildings in the power plant need pressure for fire water supply

Serial number	Water head required for fire fighting facilities (m water column)	Coal transmission system and others					
		Coal Transmission System			Auxiliary buildings		
		Indoor	Coal yard fire water cannon	Self-jetting water	Outdoor	Indoor	Automatic water spray
1	The highest point of the building or indoor most unfavorable point fire extinguishing device (m)	35.7	0	36.5	24	20	20
2	Minimum water level of fire fighting water source (m)	4.00	-4.00	4.00	4.00	4.00	4.00
3	Fixed water jet requires water head (m water column)		80	10			10
4	Pipe network head loss (m water column)	25	25	30	15	16	40
5	Total (head required) (m water column)	79.1	109	81.5	66.8	62.9	74

3.3 Fire-fighting water supply equipment selection

3.3.1 Fire-fighting water supply equipment selection

Fire-fighting water supply equipment is installed in the fire-fighting water pump room, with one Q=540m^3/h, H=1.1MPa electric fire-fighting water pump and one Q=540m^3/h, H=1.1MPa diesel fire-fighting water pump, and the diesel fire-fighting water pump is used as a backup pump for the electric fire-fighting water pump to supply water to the fire-fighting water supply system; two Q=18m^3/h, H=1.15MPa fire-fighting water stabilization pumps (1 with 1 standby), 1 fire fighting water stabilization tank for fire fighting pipe network replenishment, to keep the pipe network normal pressure.

3.3.2 Fire pump operation mode

Under normal circumstances, the water pressure of the fire fighting water supply system is maintained by the fire fighting water stabilization equipment. When the pressure of the fire fighting water supply system drops to the set value, the equipment is automatically put into operation to ensure the design pressure of the fire fighting water supply system. When a fire occurs, the pressure stabilization water supply equipment cannot guarantee the design pressure of the fire water supply system, and when the pressure of the fire water supply system drops to a certain value, the fire pump is automatically put into operation to ensure the water quantity and pressure required by the fire water supply system. When the electric fire pump stops running for some reasons, the standby diesel fire pump can be put into operation automatically within the specified time; the fire pump can be operated locally or controlled to start and stop in the control room of the central control building.

There is a return pipe on the discharge pipe of the fire pump, and the return pipe is connected to the fire pool for the inspection and test of the fire pump. There is a pressure relief valve on the return pipe, when the pressure of the pipe

network reaches the set pressure, the pressure relief valve will open automatically and the pressure relief water will flow back to the fire fighting pool to prevent the water pressure of the fire fighting water supply system from being too high. The return pipe is also equipped with a flow meter for the fire pump test. Fire fighting system is equipped with one set of microcomputer-controlled automatic inspection equipment. Fire pump in a long-term non-running state of the equipment should have automatic inspection function. Inspection controller system can accept the blocking signal from the fire alarm system, or any one fire pump start, inspection system must immediately exit the inspection state and the entire inspection control and power system power off; when the fire alarm system no blocking signal and manually start the inspection system on the local control panel before restoring its power and control power. Inspection control system fault signal sent to the main control room.

3.4 Fire fighting pools

The existing fire fighting reservoir is two 1000m^3 fire fighting and industrial pools, of which the fire fighting storage capacity is 550 m^3 respectively, and the total fire fighting storage capacity is 1100 m^3, which is greater than the total amount of fire fighting water of 1062 m^3 during the continuation of one fire in this project. fire fighting water is taken from the lower level of the pool, and the fire fighting water is not occupied by taking automatic water level control measures. The replenishment time of fire fighting water is not more than 48h. The industrial fire fighting pool is semi-underground type arrangement.

3.5 Fire fighting drainage

When indoor fire hydrant and automatic sprinkler system put out fire, the drainage is discharged into indoor ground drainage system and gathered to outdoor rainwater drainage system. When the outdoor fire hydrant is extinguished, the drainage is discharged into the outdoor rainwater drainage system. The dirty oil water of transformer is discharged into the accident oil pool or dirty oil pool, which is lifted by the pump to the treatment station of oily wastewater.

3.6 Gas fire extinguishing system

Gas fire extinguishing system should be set up in the electronic equipment room, relay room and distribution room of the electric control building, and the cable mezzanine and distribution room of the steam engine room in this project. According to the fire nature of the protected objects and the different degrees and types of fire impact, combined with the characteristics of the distribution of the protected area, the fixed IG-541 gas fire extinguishing system is used.

3.7 Configuration of fire engines

According to the information provided by the owner, the project sets up the three-stage fire station of the enterprise, and the design scheme is mainly determined according to the Technical Specification for Enterprise Fire Station (Draft for Comments). The standards of the main rooms and sites of the enterprise fire station shall conform to the provisions of the Technical Specification for Enterprise Fire Stations (Draft for Comments). The design of the outdoor training site and training tower of the enterprise fire station shall conform to the provisions of the current national standard "Design Code for Urban Fire Stations" GB 51054.

3.8 Mobile building fire extinguisher configuration

According to the National Standard of the People's Republic of China "Building Fire Extinguisher Configuration Design Code" for power plant buildings and equipment configuration of mobile fire extinguishers, and according to the differences related to the setting of fire extinguishing facilities to select and layout of different types and specifications of mobile fire extinguishers, so that in the early stages of the fire can be timely extinguished fire. The current project each building (structure) buildings according to the "building fire extinguisher configuration design specifications" (GB50140-2005) set fire extinguishers.

4. FIRE ALARM AND CONTROL SYSTEM

This project sets up an independent automatic fire alarm system, which includes various types of fire detectors, artificial alarm devices, centralized alarm controllers, fire linkage controllers, external interfaces, and corresponding auxiliary equipment. The system signal transmission adopts a two-bus alarm system with network-type distribution, and all alarm controllers on the network can perform continuous automatic inspection or manual detection of the electronic circuit part

and sensing part of all control alarm components, and have intelligent detectors and software for automatic adjustment of wet, dirty and temperature and alarm reflecting the dirty state of the probe.

The scope of fire alarm includes main plant, central control building, coal transmission system, network relay room, transformer, cable channel, desulfurization and de-selling, etc. For the main plant, coal transmission, desulfurization and de-sulfurization areas, etc. set up fire alarm areas, set up domain controllers in each alarm area, set up centralized alarms in the central control room for display and alarm, and set up a host computer in the computer room for managing and recording system information.

5. CONCLUSION

The fire protection system of thermal power plants is the most critical, and the fire protection system is an important guarantee for the safe operation of thermal power plants. In this paper, based on the fire protection measures of each system of thermal power plant, the configuration on each link of the fire protection system is clarified, hoping to provide some reference significance to the design of fire protection system of other thermal power plants.

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