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Several Ideas on Fire Detecting Alarm for Power Supply and Distribution System

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Abstract

Through the cases of fire in the power supply and distribution system for iron and steel enterprises, the basic causes and the main fire parts for the fire in the power supply and distribution system have been analyzed. Types of fire in the power supply and distribution system are summarized. Several ideas for prevention of fire that will occur in the power supply and distribution system are put forward.

Keywords: power supply and distribution system; electrical fire; monitoring of electrical fire; leakage current; detection alarm

1. Fire case analysis

Management Group of National standards *Code of design on fire protection and prevention for iron & steel metallurgy enterprises* GB50414-2007 counted Fire examples occurred over the past decade in iron & steel metallurgy enterprises, statistical results in table 1.

Table 1.Statistics of fires

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Fire sites and fire types	Times	Percentage %
Fire in Cable sandwich, Electrical basement, Cable tunnel, Cable shaft, etc.	27	36
Fire in Transformer, Control room , etc.	12	16
Combustible liquid fire based on High flash point oils in hydraulic station, lubricating oil station, oil storage room, oil pipeline corridor, etc.	11	14.67
Combustible gases or dust explosion	11	14.67
Fire on raw material transport belt , such as coal, etc.	6	8
Production facilities fire in Stainless steel cold rolling mill, grinding machine, hot rolling mill, etc.	4	5.33
Low flash point Easy-combustible fire of benzene, Coating, etc.	2	2.67
Fire in Office building, Laboratory building, etc	2	2.67
Total	75	100

As shown in the table 1, fires occurred 75 times in steel enterprises, 39 fires related to fault of power supply and distribution system, taking a ratio of 52%. According to fire statistics from the Ministry of Public Security, the incidence of electrical fires account for about 27% of the total number of fire. Thus it is clear that Prevention of electrical fires can not be ignored not only in the steel industries but also in other industries. The following three typical cases of fires cited in power supply and its distribution system of steel enterprises.

Case 1 Fire occurred in department of converter steel of a steel company a on February 28, 2000. Burnt area is 1295.4m^2, part of the electrical control system and some equipments were burnt, it made the converter stopped, and 6.157 million Yuan RMB was lost directly. 22 days were spent to repair the system, 50 million Yuan RMB was cost per day. Reason of the fire was verified after investigation, that is the cable connecting to the 3 # converter, after it get out of the cable silo, a part of it located on the ground and was bit by a small animal, this accident produced an arcing fault with a high temperature which made of combustible materials burnt.

Case 2 Fire occurred in a substation's cable tunnel of a steel plant on November 8, 1978. It forced the plant shutdown for 36 hours, 13 substations stopped producing too. The total loss is more than 3,800 million Yuan RMB. Reason of the fire is the long-term accumulation of water in Cable tunnel witch caused the insulation performance reduced, at the same, the cable had been working overload for a long time. Finally, a cable was got short-circuit breakdown and shot, it caused cable fire, then the fire spread over the hole cable tunnel, all the cables inside tunnel were burnt out.

Case 3 A welding slag caused a cable tunnel fire in a hot rolling factory of steel enterprises on April 19,1994 during its construction. It caused the factory had to stop operation more than 20 days.

Although different reasons caused the three typical fires in power supply and distribution system, there is a same scene among these three fires. That is no fire alarm system were installed, then failed to detect a fire, leading to such consequences. These teach us a profound lesson. The loss caused by fire directly, and the loss caused by stop production due to fires, and the social costs of pollution to the environment, etc. had to be considered and to be faced. It gives a serious issue to fire professionals, that is, how to solve fire detection and alarm for power supply and distribution system, how to avoid the fire and the development of fire for the normal production of escort.

2. Fire reasons analysis in power supply and distribution systems

From the statistical results of fire cases in iron and steel industry, it can be seen that there are two major fire reasons in power supply and distribution systems:

- Fire caused by power supply and distribution system itself, including aging, overloading, some unqualified parts, and local current leakage of electricity, etc.
- Fire caused by external factors of power supply and distribution system, including invasion of external fire source and insulating layers broken by small animals or faults during constructions, etc.

Evidently, these fire reasons exist not only in the power supply and distribution systems of iron and steel industry, but also in the power supply and distribution systems of other industry. The rate of incidence of electric fires in our country is around 27%, which is 10 times of the rate of Europe and America. This is a shocking figure that deserves us to consider. After further analysis, the following points are worth for us to consider.

- Part of existing power supply facilities cannot satisfy the current power usage demand, which created potential danger of electric fires. In recent years, due to fast economy development and fast growth of living standard in our country, the electricity consumption grows dramatically. Thus, some existing power supply facilities cannot satisfy the fast growth of the electricity consumption, which causes the current power supply lines to overload in a long period of time, causes the insulation layer to age quicker so that the leaking current at some parts of lines starts to increase, ignite the surrounding combustibles and cause fire.
- The lack of relevant regulations and unqualified construction create the potential danger of electric fires. Due to the lack of necessary regulations on power construction and detection, many power supply and distribution systems are subject to unqualified construction, and external insulation of some electric wires and cables were broken during construction (there are also some unqualified products), which afterwards led to too much leaking current and potential danger of electric fire when being in use.
- It is determined by the above two factors that under current national conditions effective fire prevention effort has to be made for power supply and distribution systems. However, currently this is not part of our national fire prevention regulations, which also becomes potential danger of electric fires.

3. Approaches to reducing the possibility of electric fires

Based on the analysis of the electric fire reasons for power supply and distribution systems, the writer proposes two approaches to reducing the possibility of electric fires in our country.

- Add fire prevention requirements for power supply and distribution systems in current fire prevention regulations. The national standards *Code of design on fire protection and prevention for iron & steel metallurgy enterprises* and *Code for design of automatic fire alarm system* (in revision) have elaborated fire detection and alarm regulations for power supply and distribution systems. Relevant requirements need to be put into other business regulations as well.
- Configure alarm and control system for electric fire protection scientifically to ensure normal operation of power supply and distribution systems. Alarm and control system for electric fire protection is a fire detection and alarm system which exclusively provides fire prevention safeguard to power supply and distribution systems. The design regulations for automatic fire alarm system, being in revision, requires that alarm and control system for electric fire protection needs to be configured based on building property level, electric fire risk level, and level of target to be protected. It is also required that an alarm and control system for electric fire protection shall consist of part or all of the monitoring equipments, which are leakage current-based electric fire monitoring detector, temperature-based point-type electric fire monitoring detector, line-type heat detector and electric fire monitoring equipments.

Leakage current-based electric fire monitoring detector is used to detect leaking current in circuits. The detector will send alarm signal once the leaking current reaches the preset alarming threshold. This detector effectively prevents electric fires from happening when lines are old, insulations are broken or wire terminals discharge irregularly to the ground. This kind of detector shall be installed at the output terminals of the first or the second grade switchboard based on power distribution conditions in a building.

Point-type temperature-based electric fire monitoring detector is used to detect the temperature change at the connection part of lines. The detector will send alarm signal once the temperature reaches preset alarming threshold. Because the resistance of the connection part is higher than that of cables, the temperature at the connection part increases most evidently when the line is overloaded. Therefore, electric fire can be forecasted quickly by detecting the temperature change at the connection part. The detector can be mounted in switchboard outside the cable tunnels or at other connection parts.

Line-type temperature sensing fire detector can be deployed together with cables due to its continuous detecting characteristic. The detector can not only detect temperature change of cable, but also detect the invasion of external fire source timely. In order to quickly detect fires of case 1 and 3, those fire detectors with smaller effective detection length needs to be selected to use. The national standard fire prevention regulations for steel and metallurgical industry design and design regulations for automatic fire alarm system require that such a detector should responds to fires with diameters of less than 10cm in order for this detector to be able to detect fires of case 1 and 3. When protecting the cables, the line-type temperature sensing fire detector can be connected to the electric

fire monitoring equipment, and not to the fire alarm controller. However, alarm and control units for electric fire protection should be able to send alarm signal to the fire control room.

The author believes that the use of electrical fire control system play an active role in reducing the incidence of electrical fires. Here's a case of using alarm and control system for electric fire protection.

As had electrical fires before, a furniture city in Beijing installed alarm and control system for electric fire protection. During debugging process of system, the system displays the leakage current is too large more than ten locations. Construction enterprises found leaks according to the system display, Found more than ten locations had the traces of discharge and ignition, the reason is non-standard fittings and the damaged cable insulation around the metal body discharge during Construction process. Think, if you have not installed the system, these risks are hard to find, it would be difficult to avoid the fire.

4. Final sentences

Fire is fiercer than a tiger. Too many families lost their family members in fires, and too many properties lost in fires in the past years. The dead people will not alive again, the lost properties will loss forever. The lessons fulfilled with blood teach us to try our best to do a job in fire protection. I believe, combined with implement of *Fire Law of the People's Republic of China*, with the improvement of the technical specifications in fire, with the improvement of the people's awareness on fire, the ability to fire prevention will increase continually, and the fire rates will decline day after day.

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