

The Development of Automatic Fire Alarm Standards and Related Products in China

Hongjun Ding

Shenyang Fire Research Institute, Shenyang, China

Abstract

This paper aims to introduce the development of automatic fire alarm standards and related products in China from two aspects. The first part introduces macroscopic development strategy of automatic fire alarm standards, the associated products, specific requirements, and structures of the automatic fire alarm systems and interrelations between sub-systems. The second part introduces research and application status quo and development direction of one important sub-system, electrical fire monitoring system. To meet the strict firefighting requirements in skyscrapers and complex buildings that are rapidly rising in China urban cities, the automatic fire alarm systems are required to keep pace with the urban development. Integrating various sub-fire-alarm-system to work as a whole is the development direction in China. Core of the integrated fire alarm system is the fire linkage & control unit, which unifies all sub-systems via FEC Bus to work together. Integrating all the sub-systems is a typical characteristic of Chinese automatic fire alarm system, differing from the practice in other countries.

Keywords: Chinese standard, Chinese situation, automatic fire alarm system, sub-system, FEC Bus, electrical fire monitoring

1. Preface

In the past 30 years, quite a lot of skyscrapers and complex buildings that are rapidly rising in China urban cities. These huge buildings are often built in crowded regions in super cities, like Beijing, Shanghai etc. To meet the tough firefighting demands and requirements in such buildings, China has developed many automatic fire alarm products and sub-systems tailoring for the Chinese situations. Chinese characteristics are thus reflected in the standards regulating the product, design, installation and maintenance. In recent years, China particularly raised systematic electrical fire control requirements in fire prevention and control fields,

and specifically generated an electrical fire monitoring system that is used to minimize potential electrical fire risks.

2. Status quo of automatic fire alarm system and its development directions

2.1 Status quo of automatic fire alarm system

Though developed rapidly through economy reform and opening-up in the past 30 years, development is not balanced in different regions in China. For example, east and north parts are relatively more populated and richer than north and west parts, urban cities are more populated than rural regions. Such great differences cause the fact that large buildings are coexisting with the small ones, resulting the fire-fighting needs differing significantly in different buildings and varied regions. Although fire detection and alarm products have progressed along with China society, many factors such as economy difference and detailed local requirement difference, etc. caused great differences in the locations where automatic fire alarm system is needed and also created a fact that is small and simple automatic fire alarm systems coexisting with very large and complicated ones. The small automatic fire alarm systems in China are basically in same forms as the ones in other countries in the world, but large systems have their own Chinese characteristics, differing from those in foreign countries. A typical automatic fire alarm system in China so far is consisted of “*fire detection and alarm system*”, “*fire integrated control system*”, and “*pre-alarm system*”. A complete existing automatic fire alarm system is demonstrated in Fig. 1.

China authority has realized the importance of full-process standardization in automatic fire alarm field. Chinese fire standards started from 1980s and have formed their own characteristic after a process of study and growth. In 1996, China published GB16806 “*Automatic control system for fire protection*”, which marked initiation of Chinese standard with special requirement. In 1998, the new-edition GB50116 “*Code for design of automatic fire alarm system*” was published, and China has since then started a process for automatic fire alarm system to fit its situations. In 2006, China revised GB16806 “*Automatic control system for fire protection*” into “*Fire integrated control system*”, which basically setup the present structure of automatic fire alarm system in China.

These standards are mostly formulated and administrated by *subcommittee on fire detection of National Technical Committee on Fire Protection of Standardization Administration of China (SAC/TC113/SC6)*. China has basic fire service standards, product standards, design, construction and acceptance standards, maintenance standards, and disposal standards.

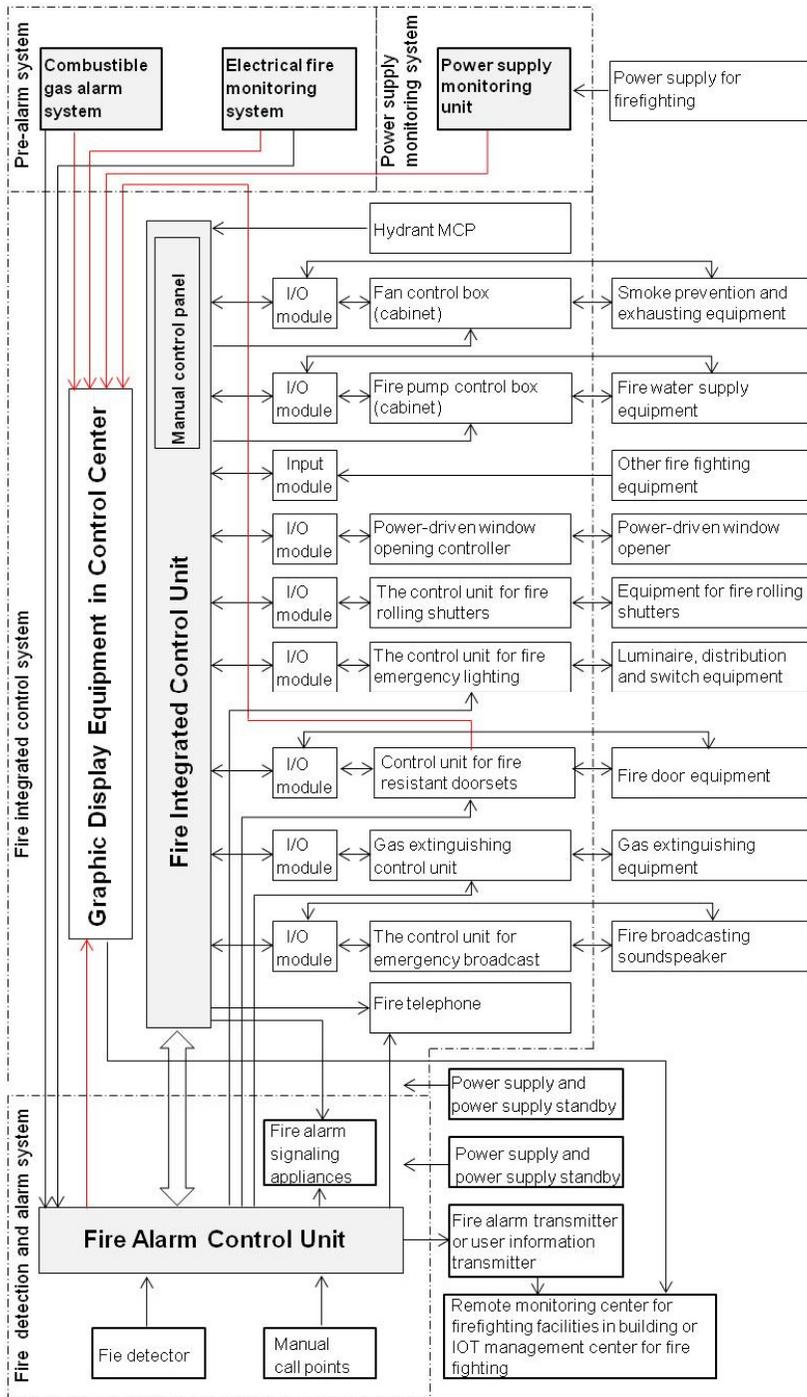


Fig. 1. Chinese existing automatic fire alarm system.

Of which the basic standards include terminology, protection rating requirements, and general technical requirements for fire control room, etc., and the standards also include fire alarm and safety system for household and self-contained fire detector, in addition to all products in the above-stated systems. All these national standards are compulsory and hence to guarantee the effective development in the field of automatic fire alarm.

2.2 Existing automatic fire alarm system forms

According to GB50116-2013 "*Code for design of automatic fire alarm system*", the automatic fire alarm system was divided into the following forms:

- Regional system: it is applicable to the locations where only alarm is required instead of linkage, and it is consisted of fire alarm panel, fire detector, manual fire alarm call points, and audible & visual fire alarm signaling appliances, etc.
- Centralized system: it is applicable to locations where both alarm and linkage are required, and it shall be equipped with one fire control room, one fire alarm panel and/or linkage panel with centralized function, as well as fire control broadcast device and fire phone, etc.
- Center control system: it is applicable to locations with multiple administrators involved, and it may be equipped with multiple fire control rooms or be consisted of more than two centralized systems.

2.3 Development direction of automatic fire alarm system

China is upgrading its standards in a new round in recent years. In 2013, China published GB50116 "*Code for design of automatic fire alarm system*", which raises new requirements for structure and service of the fire alarm system, and these requirements are more close to practical demands in China. The automatic fire alarm system in China will advance in direction of integration to fit huge and complicated buildings or building groups and crowded areas in China or countries with similar conditions. Integrated fire alarm system will have fire linkage panel as its core that integrates all sub-systems through FEC Bus to form an integral structure. The sub-systems include electrical fire system, gas extinguishing system, broadcasting system, fire door monitoring system, fire roller shutter system, fire emergency lighting system and evacuation indicating system, and fire power supply monitoring system, etc. At the same time, China has also revised the standards for two products in the automatic fire alarm system: smoke detector, and fire alarm panel, and both of them have been approved by China authority. These two standards are more reflecting special technical and operating requirements in China. For example, the photoelectric smoke detector shall be able to pass the fire sensitivity test with its response threshold value larger than 0.3, and also

be able to give specific failure alarm after it is polluted, etc. The new-edition standard for fire alarm panel further raises concepts and requirements for alarm bus, linkage bus, and device bus, which responds to GB50116 "*Code for design of automatic fire alarm system*" to drive fire control integration. Of course, other main technical indexes in the standards keep consistent with ISO. The objective of a complete automatic fire alarm system that is developing in China is shown in Fig. 2, and the objective of linkage control system is shown in Fig. 3.

3. Status quo and development of electrical fire monitoring system

As a pre-alarm sub-system of automatic fire alarm system, electrical fire monitoring system plays an irreplaceable role in fire prevention. Electrical fire monitoring system is among the important electrical fire prevention measures, and it is mainly used to monitor electric failures to avoid fire accident.

3.1 Electrical fires in China

The statistics in recent 10 years show that the fires in each year caused by electric failures take up about 30 % of the total fire accidents and 50 - 80 % of major ones. China faces more severe situation in electrical fire than that of any other developed countries and regions.

3.1.1 Applications of existing electrical fire monitoring systems

3.1.1.1 Applications and setup of residual current electrical fire monitoring detectors

Residual current electrical fire monitoring detectors are mainly used to monitor working state of distribution circuit and monitor potential failures and fire risks in time. The residual current in the whole distribution circuit may increase when the circuit or any electrical device is aged, damaged, moisten, or when its insulation is in poor condition if it is not installed correctly, etc. The detector may give alarm for troubleshooting and reduce the probability of electrical fire.

This type of detectors may be set and installed so as to fit their applications, and their protection scopes may be determined according to natural leakage currents of the targeted circuits. Their functions shall be exerted to the greatest extent to maximize their protection scopes and minimize their quantity, viz. if the natural leakage current at level-1 distribution point meets the setting requirement, detector for level-2 will not be necessary.

Pure-resistance residual current in the circuit may be regarded as leakage current produced as a result of insufficient insulation, or in other words, the electrical fire monitoring detector for testing pure-resistance residual current may also work as insulation detector.

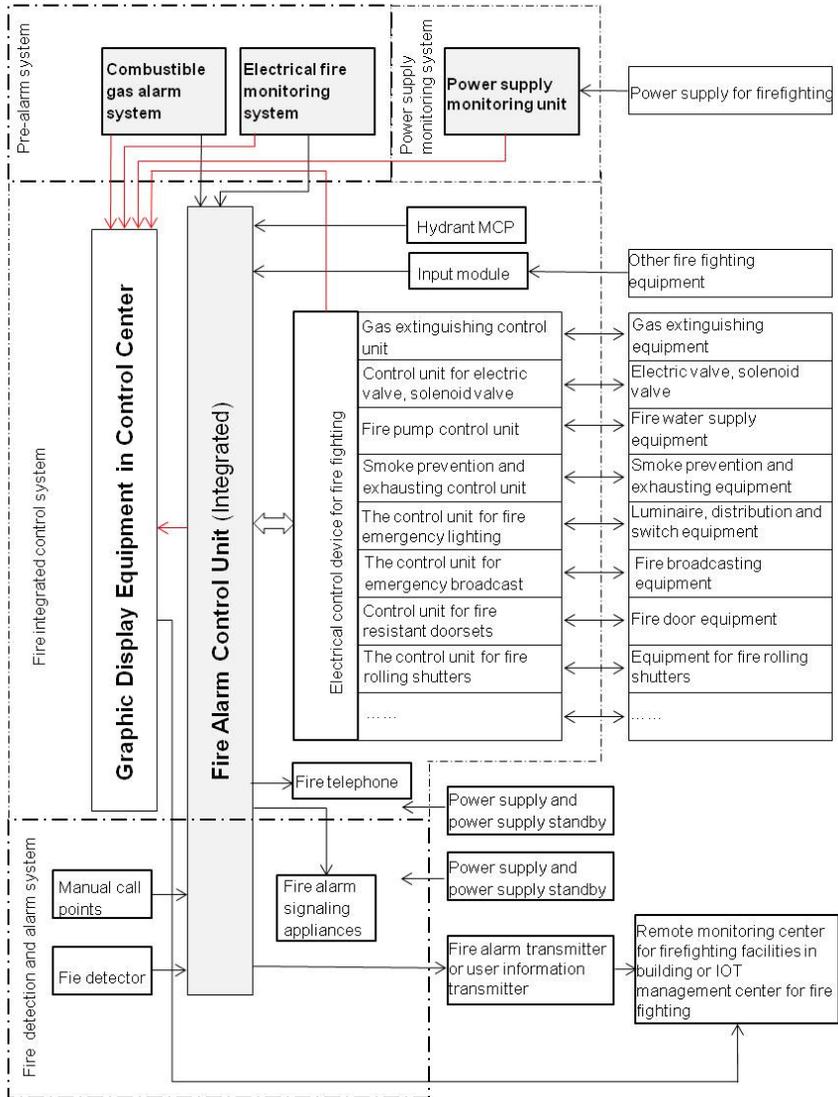


Fig. 2. Objective of a complete automatic fire alarm system.

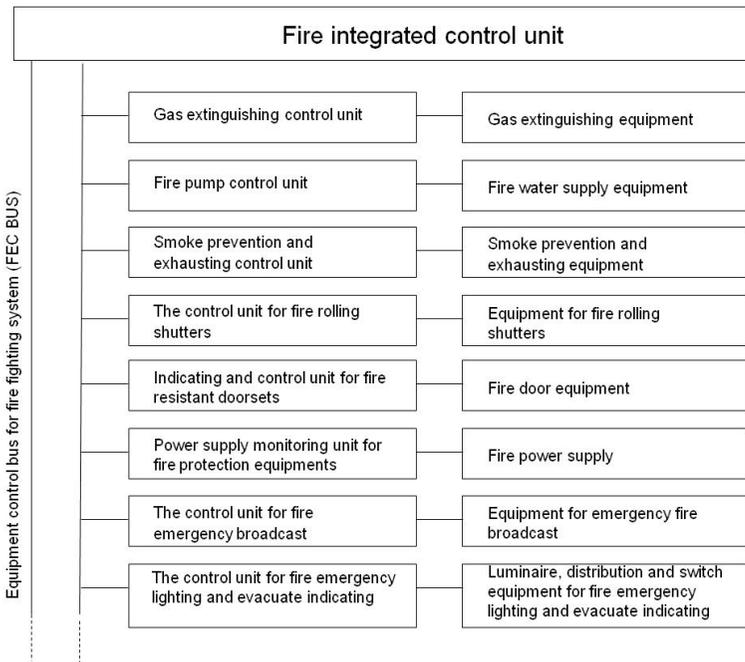


Fig. 3. Objective of a linkage control system.

3.1.1.2 Applications and settings of temperature sensing electrical fire monitoring detectors

Temperature sensing electrical fire monitoring detector is mainly used to monitor overheat caused for overloading, poor contact, or increased contact resistance of a joint in the distribution system or the whole circuit, which may ignite surrounding combustibles to cause a fire. According to their characteristics, temperature sensing may be divided into 2 types: contact type and non-contact type, which may be selected for appropriate protection target.

In the whole circuit, joint may be most easily overheated, and generally most joints are centralized in the distribution cabinet (or panel), which makes it possible for centralized arrangement of the temperature sensing detectors, so the temperature sensing detectors in distribution system shall generally be set in the distribution cabinet. Of course, joints also exist in power transmission, for which temperature sensing detector may also be used.

3.1.1.3 Applications and settings of arcing fault detectors

Terminal of a distribution circuit may cause fire is mostly arised from connection to electrical equipment directly, and its main failures for causing fire include: temperature rise caused by excessive contact resistance or overloading, etc., and arc discharging caused for poor

contact or insulation damage, etc. So it is very important to protect terminals of the distribution circuits.

Arcing fault detector shall be set at the cable inlet on the terminal distribution panel according to its working principle. Once this part of circuit or any electrical device in the circuit has arc discharge, the detector may detect it in time for timely handling.

3.1.2 Existing standards for electrical fire monitoring system

Electrical Fire Prevention Branch of National Fire Protection Standardization Technical Committee (SAC/TC113/SC15) was built up on Dec. 11th, 2015, which was mainly responsible for formulating the standards for electrical fire prevention. The electrical fire codes have formed as series of standards. So far, four product standards have been released to standardize the electrical products used in electrical fire detection and protection. Namely, part 1: *electrical fire monitoring equipment (GB14287.1-2014)*, part 2: *residual current electrical fire monitoring detectors (GB14287.2-2014)*; part 3: *temperature sensing electrical fire monitoring detectors (GB14287.3-2014)*; part 4: *arching fault detectors (GB14287.4-2014)*.

3.2 Reasons for high frequency of electrical fires in China

Dozens of years ago, power was mostly used for lighting in China, but it has been developing very quickly since economy reform and opening-up. All kinds of electrical equipment start to be used and power consumption increases quickly within very short period, but standards/codes and product cannot meet the power consumption demand, which is the main reason for electrical fire in China. As a result, electrical fire occurred more frequently than any developed countries and region. As a matter of fact, developed countries and regions experienced a relatively slower and more steady development process and have reached a relatively stable state, and have basically reached a relatively harmonious status in power consumption in many aspects including power usage mode, living habit, and knowledge on safety, etc., so electrical fire are much lower than that in China. Underdeveloped countries and regions have not so many electrical fires as compared with China because their power consumption is still lower. To sum up, high frequency of electrical fires in China is mainly caused by the following 6 reasons:

- Power supply and distribution lines are not improved with the living standard.
- The products in power supply and distribution system are in low quality.
- Inadequate safety of power supply and distribution system
- Low construction quality
- Lack of protection in policy
- The electrical products fail to meet fire protection requirements.

3.3 Development direction of electrical fire monitoring system

Electrical fire risk control is a systematic engineering, for which pertinent measures shall be taken according to its causes, and China is improving gradually in this aspect. If the functions of the electrical fire monitoring system are fully understood and the system is used correctly, many potential electrical fires may be discovered in advance, and electrical fires will be reduced greatly.

3.3.1 Objective structure of electrical fire monitoring system

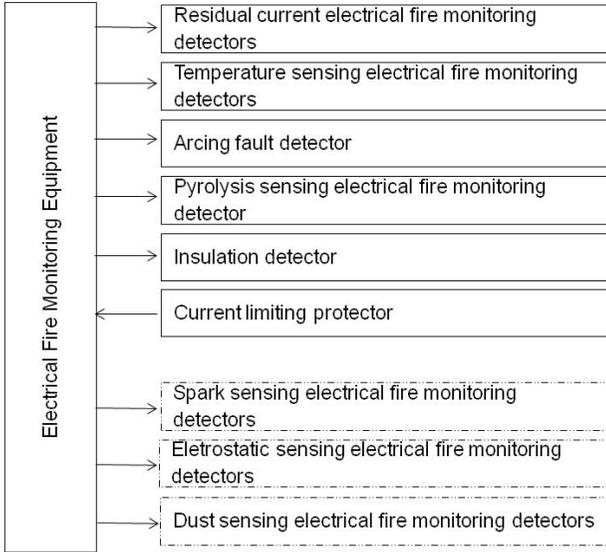


Fig. 4. Objective structure of electrical fire monitoring system.

3.3.1.1 Applications and setup of pyrolysis sensing electrical fire monitoring detector

All fires caused by electric failure have a temperature rise process before visible flame occurs, and the organic matters included in the distribution system or electric components, etc. will be paralyzed successively with the temperature rising, so pyrolysis sensing electrical fire monitoring detector may detect the temperature rise caused by electric failure and give alarm before visible flame occurs, as such fire failures may be handled timely and potential fire may be avoided.

Because of the basic operation principle, pyrolysis sensing electrical fire monitoring detector may be used in all places with potential electrical fire hazard, and it may be set inside the electric devices such as electric cabinets and communication cabinet, etc. or be set in the cable tunnel.

3.3.1.2 Applications and setup of current limiting protector

All electrical fires caused by temperature rising or arc discharge may generally be handled within a period which the detector may give alarm in time to remind people dealing with them. However, it is not possible to give alarm in case of electrical fire caused for short circuit, and such fire may only be handled through cutting off the circuit in time. Current limiting protector is mainly used for specific terminal circuit under direct load that has short circuit risk, and it may, within very short time, discharge the energy produced by short circuit and cut off the circuit to avoid fire. Current limiting protector may be set at cable incoming or outgoing point in the terminal distribution board according to characteristic of the targeted circuit.

For a situation with high electrical fire potential, other electrical fire protection products may be employed to meet the demand for electrical fire prevention, such as electrostatic sensing electrical fire detector, dust sensing electrical fire detector, and spark sensing electrical fire detector, etc. to meet electrical fire control demands in different occasions.

3.3.2 Development direction of standards for electrical fire monitoring system

As one part of electrical fire prevention and control system engineering, the standard for electrical fire monitoring system is improved gradually in China. The draft standards for pyrolysis sensing electrical fire monitoring detector and current limiting electrical fire protector have been completed for approval presently.

In addition to electrical fire monitoring system, China also has sockets and switches with fire monitoring function, and it is formulating such standards as “*Rules for inspection and test on electrical fire prevention*”, “*Rules for assessment of electrical fire hazards in civil buildings*” and “*General requirements for fireproof performance of electrical products*”, etc. As the series national standards for electrical fire monitoring system are proceeding, the electrical safety level in building will be improved, electrical fire monitoring products will be widely used, and electrical fires will be reduced greatly in China.

4. Conclusion

Standard is the core in development of an industry, and an industry will not be able to develop without standard. Series of Chinese standards for automatic fire alarm system are leading the fire detection and alarm industry to meet actual demands and fit more and more huge and complicated buildings or building groups, and are also leading the fire detection and alarm products to fit the current situations in China and similar developing countries at higher price-performance ratio.

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