消 防 處
防 火 總 區
香港九龍尖沙咀東部康莊道 1 號 5 樓
消防總部大廈

FIRE SERVICES DEPARTMENT
FIRE PROTECTION COMMAND
FIRE SERVICES HEADQUARTERS BUILDING,
No. 1 Hong Chong Road, 5/F.,
Tsim Sha Tsui East, Kowloon,
Hong Kong

本處檔號 Our Ref.: (49) in FPB 314/07 III
來函檔號 Your Ref.:
電訊掛號 Telex: 39607 HKFSD HX (24 小時 Hours)
圖文傳真 Fax: 852-2723 2197
電 話 Tel. No.:

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FSD Circular Letter No. 7/95
Automatic Fire Detection System
- Design and Maintenance Considerations

In accordance with the Code of Practice for Minimum Fire Service Installations and Equipment, provision of automatic fire detection (AFA) system is required in most types of premises in order to give early warning of fire dangers. At present, AFA system shall be designed and installed in accordance with the specifications given in the Rules of the Fire Offices' Committee For Automatic Fire Alarm Installations (12th Ed.). However, these Rules do not give much guidance on the practical engineering details on which project consultants/engineers and Registered Fire Service Installation Contractors should consider before planning, designing and installing their AFA systems. Improper design and installation of AFA systems have caused numerous unwanted alarms to building users and the situation is very undesirable.

As part of the measures to let consultants/engineers and Registered FSI Contractors to get more understanding on various types of AFA equipment and to design and install healthy and reliable installations, the Working Group for Fire Service Installations Inspection Procedures has prepared a Paper (copy attached) in respect of some important design and maintenance considerations on AFA installation.

All project consultants/engineers and Registered FSI Contractors are strongly advised to make reference to the Paper during their design and installation of AFA systems. Notwithstanding the above, project consultants/engineers and contractors should exercise their own discretions in selecting the most suitable type of detection equipment and system design appropriate to their building projects so as to suit large varieties in system complexities.

Should you have any problems, please contact Fire Service Installations Division of Fire Protection Bureau at telephone no. 2733 7563.

Signed
(TSANG Kwong-yu)
for Director of Fire Services

Automatic Fire Detection System
Design and Maintenance

1. General

Automatic fire detection (AFA) system provides warning of fire danger and permits counter-action to be taken usually before the danger has reached serious proportion. Thus, it is an important installation in the protection of life and property. This places great responsibilities on the design engineer and the Registered FSI Contractor of such system for each building posed different problems in terms of fire development and spread. An AFA system must be designed according to the type of building, its intended usage and construction so that in combination with other fire protection measures, fire damage can be kept to a minimum.

The planning of an AFA system is not simply an application strictly following installation rules and regulations but an engineering technique with careful consideration in system planning, engineering design, selection of equipment, system sensitivities as well as proper maintenance to ensure reliable functioning of the system.

In considering system design, the following status of fire development should be noted:-

1.1 Slow Fire Development

This type of fire is in general characterised by smoke development during the incipient stage, little convection heat and very little, or no heat radiation.

With the present state of fire detector technology smoke detector is regarded as the best type of detector for this type of fire.

1.2 Fast Fire Development

Already in its incipient phase, this type of fire is characterised by smoke and convection heat, as well as heat radiation. Heat or infra-red detectors (or flame detector) will be suitable to provide proper response.

2. System equipment

2.1 Fire Detectors

Fire detectors are those parts of a fire detection system which automatically measure, compare or detect the aerosol or change in fire phenomena such as smoke, heat and radiation and transmit this information to a control unit for evaluation.

2.2 Annunciation Panel

There are two main types of panel :-

2.2.1 Conventional electronic type panel

It is a type of solid-state electronic panel widely adopted in AFA system and

characterized by :-

a. transmission of one signal per electrical circuit;
b. simple system design;
c. built in features plus external wirings with monitoring of signal circuit fault.

2.2.2 Addressable type panel

It is a multiplex communication system having the arrangement that a no. of detectors, manual call points, water flow switches and other alarm devices are wired onto a fire detection loop or zone. It is suitable for large and complicated building.

A useful feature of this type of system is that it simplifies on-going maintenance of system. It is capable of testing the sensitivity of detectors and giving pre-warning signal to the management team for maintenance if the detectors have reached pre-determined response level. Some types of systems do not activate an alarm merely on the initial report of one detector but are capable of engaging routines which check back or seek confirmation from adjacent detectors. Thus, it reduces the incidence of unwanted alarm signals while maintaining the integrity of the system without jeopardizing the high level of protection to premises.

Its advantageous features also include high flexibility in programming, less wiring, self-monitoring and latest states reporting.

3. Types of Fire Detectors

3.1 Smoke detector

It can be employed for both slow and fast development fires where visible and/or invisible fire aerosols are generated.

3.1.1 Ionization smoke detector

It responds to all types of fire aerosols and therefore has the widest application range, but most susceptible to generate unwanted alarms in response to changing environment.

3.1.2 Photoelectric (or Optical) smoke detector

Light-scattering detector responds to a sufficiently great concentration of visible and light-reflecting smoke. Therefore, it is most suitable to apply in area where slow development fire where visible aerosol is expected.

Owing to its characteristic , it is less sensitive than ionization smoke detector but still provides better response than other types of fire detectors.

3.2 Heat Detector

It is suitable in area where rapid development of fire is expected.

3.2.1 Rate of rise temperature heat detector

It detects a fast development fire. When the temperature rises faster than a pre-determined rate of increase, an alarm will be given off.

3.2.2 Fixed temperature heat detector

It gives an alarm as soon as a pre-determined temperature is exceeded.

3.2.3 Combination type heat detector

It gives an alarm whenever the temperature rises faster than a pre-determined rate of increase or reaches a pre-determined temperature setting.

3.3 Infra-red/Ultra-violet Detector

It is suitable for detecting fire with particular to radiation of a specific range of wavelength, e.g. visible or glowing flame but with little smoke to obstruct the detector' s line of vision at initial stage.

4. Causes of Unwanted Alarms

To understand the problem of unwanted alarms from AFA system, design engineer and Registered FSI Contractor should carefully consider all possible causes of alarms. From experience and statistics, the following are some of them :-

4.1 Environmental factor

a. Dusty environment
b. Fog and high humidity
c. High air velocity
d. Insects
e. Transient condition

4.2 Human activities

a. Smoking
b. Steam from cooking or shower
c. Burning joss sticks
d. Construction works
e. Installation contractor works
f. Vehicular exhaust fume
g. Malicious action

4.3 Installation design and maintenance

a. Electrical transient
b. Inappropriate design
c. Defective equipment
d. Lack of cleaning and maintenance

5. Design Consideration

In planning the design and installation of an AFA system, design engineer and registered FSI contractor should carefully consider the following criteria :-

5.1 Selection of Detectors

Each type of detector has its own characteristic and sensitivities range. Design engineers and Registered FSI Contractors have to carefully consider the environmental condition and the nature of fire development of the area before a certain type of fire detector is installed thereat. Otherwise, frequent unwanted alarms will be resulted when the building is occupied.

The following are some hints for the design engineers and Registered FSI Contractors to note :-

5.1.1 Ionization smoke detector

This type of detector will give alarm whenever the ion movement in its detection chamber is affected by external aerosol or other changing environmental condition. Therefore, it is not suitable in area where :-

a. relative humidity continuously exceeds 95%;
b. continuous excessive air current greater than 10 m/s exists;
c. excessive dirt (fatty or wet) or dust are generated;
d. there are activities generating fumes, e.g. welding, brazing etc.,
e. hardening furnaces or forges are installed;
f. there is no good ventilation system;
g. running vehicles generate exhaust fumes;
h. in communicating with outside environment;
i. with uncontrollable air quality; or
j. heat detector had already served the purpose of fast fire detection.

5.1.2 Photoelectric (or Optical) smoke detector

It is not suitable to be applied in area where :-

a. fire with invisible aerosols is expected. For example, open combustible fire, etc.
b. fire with very dark smoke is expected. For example, certain solvents, plastics, rubber, etc.

c. it is used as parking garages, truck drive-way, rail or diesel locomotives driveway;

d. steam from cooking process exists, e.g. restaurants in which food is prepared at dining area.

5.1.3 Rate of rise temperature heat detector

It is not suitable to be applied in following situations:-

a. kitchen, dining area where cooking process is allowed, etc.,

b. near opening to external subject to heat air stream;

c. area where sharp change of temperature is experienced;

d. relative humidity continuously exceed 95%;

e. high ceiling area, i.e. greater than 7.5 m;

f. Smouldering fire is expected; and

g. area where smoke detector is suitable.

5.1.4 Fixed temperature heat detector

It is not suitable to be applied in following areas :-

a. continuous high ambient temperature area, e.g. boiler room, heating plant, etc.

b. high ceiling area;

c. smouldering fire is expected;

d. area where smoke detector is suitable.

5.1.5 Combination type heat detector

This type of heat detector should be considered first if smoke detector is found not suitable for protecting the environment.

5.1.6 Flame detector

It is sensitive to glowing fire and has long coverage distance. Therefore, it is suitable in high ceiling area (upto 30m) with spreading fire, e.g. aircraft hanger. It is not suitable for area where :-

a. subject to deceptive influence such as reflection of sunshine, lightning, strong light from cars and trains, etc.;
b. welding process exists;

c. fire with heavy smoke before flame is expected; and

d. the detection line of sight is easily obstructed.

5.2 Equipment compatibility

To avoid unwanted alarm due to incompatibility between the electronic characteristics of detector and the annunciation panel, it is necessary to make sure that the selected detector model has been tested together with the panel on a system basis. Reference from the product guides from testing organizations or laboratories recognized by F.S.D., such as Loss Prevention Council (LPC), Underwriters' Laboratory (UL) and Factory Mutual (FM), may be used in selecting the correct combination of detection equipment.

5.3 Signal Integration Device

A signal integration device should be factory built inside the detector or panel, which should be approved in respect of design by a recognized testing authority recognized by F.S.D. The signal integration device, or other approved device, should permit the transmission of the alarm to the Computerized Fire Alarm Transmission System to be held by NOT more than 30 seconds, and once set it must not be adjustable at field.

Detectors as described above which are permitted to be installed must be of a design which allows them to be clearly identifiable when installed to the satisfaction of F.S.D. The precise locations of these detectors or panels must be notified in writing to F.S.D. and clearly marked on plans to permit checks to be made from time to time.

5.4 Detector installation

The precise installation locations of detectors should be carefully selected during construction stage to avoid any interference from other services installations, the activities or environment of the concerned areas. These factors may on one hand affect the response of the detector and on the other hand cause unwanted alarm.

5.5 Design Review

In some occasions, unwanted alarms from AFA system could only be pictured when the building is occupied and put in use. Therefore, design engineers and Registered FSI Contractors should review their original design and installation periodically after building handover and to dig out the hidden problem.

6. Maintenance of System

Improper and insufficient maintenance of automatic fire detection and alarm system is believed to be one of the major causes of unwanted alarms.

Maintenance such as cleaning and re-calibration of detectors and annunciation panel shall strictly follow the period set in manufacturer's instructions, and whenever dirt or dust is found on the detector.

Preventive or group maintenance of the system rather than maintenance only after fault is found effective in avoiding unwanted alarm.

The maintenance programme as recommended BS 5839: Part 1: 1988 should be taken as a useful

reference and followed wherever applicable.

7. Conclusion

Proper design, installation and maintenance are vital factors to ensure the effectiveness of the system. Although ionization smoke detector is the most sensitive and commonly used detector, frequent unwanted alarms will be resulted if design engineer and Registered FSI Contractor do not carefully consider its suitability and compatibility with the environment in which it is installed.

Photoelectric detectors in most situations can provide satisfactory response but less susceptible to changing environmental conditions. Also, combination type heat detector can also give reasonable response in areas where installation of smoke detector is inappropriate.

Analogue addressable systems, which are less likely to raise unwanted alarms caused by system failure, is recommended for buildings where complicated or extensive AFA systems are installed.

Design engineer and Registered FSI Contractor should correctly select the appropriate type of detectors in their system designs and carefully consider the future maintenance and unwanted alarm problems. A healthy installation is important for the protection of life and property but without causing unnecessary nuisance to building users.