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An American National Standard

Standard Guide for Shipboard Fire Detection Systems[1]

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ε[1] NOTE—Reapproved with editorial changes in October 2012.

1. Scope

1.1 This guide covers the selection, installation, maintenance, and testing of shipboard fire detection systems other than sprinkler systems.

1.2 This guide is intended for use by all persons planning, designing, installing, or using fire alarm systems onboard vessels. As it includes regulatory requirements, this guide addresses those vessels subject to regulations and ship classification rules. However, the principles stated herein are also suitable for unregulated commercial vessels, pleasure craft, military vessels, and similar vessels that are not required to meet regulations for fire detection and alarm systems.

1.3 *Limitations*—This guide does not constitute regulations or ship classification rules, which must be consulted when applicable.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *Code of Federal Regulations:*[2]
Title 46, Part 76.25
Title 46, Part 76.30
Title 46, Part 76.33
Title 46, Part 161.002

2.2 *NFPA Publications:*[3]
NFPA 72E Standard on Automatic Fire Detectors

2.3 *SOLAS Regulations:*[4]
SOLAS II-2/13-1
SOLAS II-2/12

3. Terminology

3.1 *Definitions:*

3.1.1 *accommodation space*—those spaces used for public spaces, corridors, lavatories, cabins, bunkrooms, staterooms, offices, hospitals, cinemas, game and hobby rooms, barber shops, pantries containing no cooking appliances, and similar spaces.

3.1.2 *alarm signalling device*—an audible or visual device such as a bell, horn, siren, strobe, flashing, or rotating light used to warn of a fire condition.

3.1.3 *annunciator*—an audible and visual signalling panel that indicates and displays the alarm, trouble, and power conditions of the fire detection system.

3.1.4 *approved*—acceptable to the organization, office, or individual responsible for accepting equipment, an installation, or a procedure.

3.1.5 *automated machinery space*—a space containing machinery that is automated to allow: (*a*) periodic unattended operation by the crew; and (*b*) continuous manual supervision by the crew from a central room (enclosed) or remote location.

3.1.6 *control panel*—an electrical panel that monitors and controls all of the equipment associated with the fire detection and alarm system.

3.1.7 *control space*—an enclosed space within which is located a ship's radio, main navigating equipment, emergency source of power, or the centralized fire recording or fire control equipment, but not including individual pieces of firefighting equipment or firefighting apparatus that must be located in the cargo area.

3.1.8 *hazardous (classified location)*—locations where fire or explosion hazards may exist due to flammable gases or vapors, flammable or combustible liquids, combustible dust, or ignitable fibers or flyings.

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[2] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

[3] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.

[4] Available from International Maritime Organization, 4 Albert Embankment, London, England SE1 7SR.

3.1.9 *listings*—equipment or materials included in a list published by an organization certified to perform product evaluations. This organization maintains periodic inspections of production of the listed equipment or materials. The listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

3.1.10 *machinery spaces of Category A*—those spaces and trunks to such spaces which contain: (*a*) internal combustion machinery used for main propulsion; or (*b*) internal combustion machinery used for purposes other than main propulsion where such machinery has, in the aggregate, a total power output of not less than 500 hp (375 kW); or (*c*) any oil-fired boiler or oil fuel unit.

3.1.11 *main vertical zones*—those sections, the mean length of which does not, in general, exceed 131 ft (40 m) on any one deck, into which the hull, superstructure, and deck houses are required to be divided by fire-resisting bulkheads.

3.1.12 *manually activated fire alarm box*—a box containing an electrical switch which, when manually operated, sends an alarm signal to the control panel (referred to as "Manually Operated Call Points" by SOLAS).

3.1.13 *roll on/roll off cargo space*—a space not normally subdivided in any way and extending to either a substantial length or the entire length of the ship in which cargo, including packaged cargo, in or on rail or road cars, vehicles (including road or rail tankers), trailers, containers, pallets, or demountable tanks (in or on similar stowage units or other receptacles), can be loaded and unloaded normally in a horizontal direction.

3.1.14 *self restoring*—the ability of a device to reset itself automatically after being activated.

3.1.15 *service space*—spaces used for galleys, pantries containing cooking appliances, locker rooms, mail rooms, specie rooms, store rooms, workshops other than those forming part of the machinery spaces, and similar spaces, as well as trunks to such spaces.

3.1.16 *special category space*—an enclosed space above or below the bulkhead deck intended for the carriage of motor vehicles with fuel in their tanks for their own propulsion, into and from which such vehicles can be driven and to which passengers have access.

3.1.17 *supervised*—describes an electronic method of monitoring the electrical continuity of the circuits and devices of a fire detection and alarm system. This is normally accomplished by constantly passing a small current through the circuits and devices.

4. Significance and Use

4.1 The purpose of a shipboard fire detection system is to provide warning so as to reduce the life safety threat from fire and to minimize the fire threat to the operation of the ship. Given that few ships are identical either in size or layout, it follows that the fire detection system will have to be custom designed accordingly. A well-designed system provides a reasonable substitute to having crew members on constant fire watch in every protected space where a fire might occur.

4.2 The basic function of the fire detection system is to automatically and reliably indicate a fire condition as quickly as is practical and to alert responsible individuals of a fire's existence and location. This system design and application guide addresses the individual steps in the layout of the system and provides an overview of the information needed to design a system.

4.3 The U.S. Coast Guard and the International Convention for the Safety of Life at Sea (SOLAS) regulations have been stated as requirements within this guide. Additional guidelines to assure complete and effective systems or to incorporate good industry practices are stated as recommendations.

DESIGN AND APPLICATION

5. System Types

5.1 Fire detection and alarm systems used on vessels are typically of the following types:

5.1.1 *Electrical Automatic Fire Detection and Alarm Systems*—these systems consist of a control panel, various types of fire detectors, manually actuated fire alarm boxes, audible and visual alarms, and appropriate power supplies. The control panel monitors the fire detection and alarm circuits and generates appropriate signals when an automatic fire detector or manual fire alarm box is activated.

5.1.2 *Manual Fire Alarm Systems*—a similar system without automatic fire detectors is referred to as a manual fire alarm system but is otherwise identical. Operation is initiated by individuals who activate a manually actuated fire alarm box that incorporates an electrical switch. This guide is primarily concerned with electrically operated automatic and manual fire detection and alarm systems.

5.1.3 *Pneumatic Fire Detection Systems*—These systems consist of a closed length of pneumatic tubing attached to a control unit. Air chambers called heat actuated devices (HADs) are often attached to the tubing in the protected area to increase the volume and thus the sensitivity of the system. As temperature builds up in a fire, the air in the tubing expands, moving a diaphragm in the control unit. A small calibrated vent compensates for normal changes in ambient temperature. The diaphragm activates a release mechanism or a set of contacts. Because pneumatic fire detection systems are self-contained (that is, independent of outside sources of power), they are often used to activate small automatic fire extinguishing systems such as are installed in paint lockers and emergency generator enclosures. U.S. Coast Guard Requirements for pneumatic fire detection systems may be found in Title 46, Code of Federal Regulations, Part 76.30.

5.1.4 *Sample Extraction Smoke Detection Systems*—These systems consist of a piping system connected to a control unit with a suction blower. These systems continually draw samples from the protected spaces to the control unit where a light source and photocell monitor the sample for smoke. Sample extraction smoke detection systems are often used in cargo holds because they are less likely than individual spot-type smoke detectors to operate from dust or localized sources of smoke such as vehicle exhausts. Also, the more delicate electronics and control equipment can be located remote from the harsh environment of a cargo hold. These systems are often combined with a carbon dioxide extinguishing system, using the carbon dioxide distribution piping to draw samples from the protected areas. Detailed requirements for sample extraction smoke detection systems are contained in proposed SOLAS Regulation II-2/13-1 and in U.S. Coast Guard regulations found in Title 46, Code of Federal Regulations Parts 76.33 and 161.002.

5.1.5 *Automatic sprinkler Systems*—Systems that are constantly pressurized and connected to a continuous supply of water and fitted with a suitable means for automatically giving visual and audible alarm signals may also be considered to be fire (heat) detection and alarm systems. Detailed requirements are found in SOLAS Regulation II-2/12 and U.S. Coast Guard Regulations, Part 76.25.

6. Classification of Fire Detectors

6.1 Heat detectors are devices that sense a fixed temperature or rate of temperature rise. Heat detectors work on one of the three operating principles outlined in 6.2, 6.3, and 6.4.

6.2 A fixed temperature detector is a device that responds when its operating element becomes heated to a predetermined level. Because of the time required to heat the mass of element to its preset level, there is usually a lag time, referred to as the "thermal lag," between the time the surrounding air reaches the operating temperature and the time the operating element reaches its preset operating temperature. There are seven temperature classification ranges. In locations where the ceiling temperature does not exceed 100°F (38°C), detectors with an operating range of 135 to 174°F (57.2 to 78.9°C) should be used. These are termed "ordinary" temperature classifications. Several types of temperature-sensitive operating elements are used, such as:

6.2.1 *Bimetallic elements, which consist of two metal strips with different coefficients of expansion fused together so that heating will cause the element to deflect, making electrical contact.*

6.2.2 *Electrical conductivity elements, which are devices whose electrical resistance varies as a function of temperature.*

6.2.3 *Certain automatic heat detectors use fusible alloy elements or liquid expansion elements that operate at a fixed temperature. These devices are nonrestorable and are prohibited by SOLAS.*

6.3 A rate-of-rise detector is a device that operates when the temperature rises at a faster than predetermined rate. Since operation does not depend on having reached a fixed temperature level, it responds to a rapid temperature rise more quickly than a fixed temperature detector. However, it does not respond to a slow developing fire regardless of how high the temperature gets. In a typical rate-of-rise detector, heated air in a chamber expands to deflect a diaphragm that operates electric contacts.

6.4 A rate of compensation detector is a device which, because of differential expansion of several components, responds when the temperature of the air surrounding the detector reaches a predetermined level, regardless of the rate at which the temperature rises. It is designed to avoid the thermal lag time that is inherent in a fixed temperature detector. This device is also known as a rate anticipation detector.

6.5 Combination heat detectors take advantage of more than one operating principle in a single detector housing. Combination fixed temperature and rate-of-rise detectors are most common.

6.6 Smoke detectors are devices that detect visible or invisible products of combustion. They work on several operating principles as follows:

6.6.1 Ionization smoke detectors have a small radioactive source that ionizes the air within a chamber, making it conductive so that a small current flows between electrodes. Smoke particles entering the chamber interfere with the free flow of ions and reduce the current, activating the detector.

6.6.2 Photoelectric smoke detectors use a light source and photocell to detect the presence of smoke. Several types may be used on ships:

6.6.2.1 In the light obscuration type of detector, smoke particles that enter between the light source and the photocell reduce the amount of light reaching the photocell, causing the detector to activate. Projected linear beam smoke detectors are light obscuration smoke detectors. The light source and photocell are separately housed, and the light beam is projected across the protected area. The alignment between transmitter and receiver is critical for proper operation of this device. Shipboard vibration and flexing may affect proper alignment.

6.6.2.2 In a photoelectric light-scattering smoke detector, the components are arranged so that light does not normally reach the photocell. When smoke particles enter the chamber, they reflect or scatter some of the light onto the photocell, activating the detector.

6.6.3 Sample extraction smoke detection systems as described in 5.1.3 operate on one of the principles covered in 6.6.2.1 and 6.6.2.2.

6.7 Flame detectors are devices that detect infrared (IR), ultraviolet (UV), or visible light produced by a fire. To avoid activation by sources or radiation other than fires such as welding, sunlight, and so forth, flame detectors are usually designed to sense light modulated at a rate characteristic of the flicker rate of flames, or to detect certain bands of IR or UV or visible radiation characteristic of flames, or some combination of these features. A combination of these features is used in some applications to reduce the probability of false alarms.

6.8 Other classifications of fire detectors include: (*a*) gas detectors that sense gases produced by burning substances; (*b*) resistance bridge smoke detectors that sense change in conductivity when smoke particles and moisture from fire are deposited on an electrical grid; (*c*) cloud chamber smoke detectors in which moisture is caused to condense on smoke particles drawn into a chamber; and (*d*) heat-sensitive cable in which high temperature softens the insulation separating two conductors, causing reduced resistance or shorting of the conductors, as well as devices that operate on other principles. Such detectors are seldom used on ships.

6.9 Combination detectors combine the principles of one or more classifications of fire detectors or detection principles in a single device. A common example is a fixed temperature-rate-of-rise heat detector.

6.10 All detectors, except sprinklers, are required by regulation to be restorable so that they can be tested for correct operation and restored to normal condition without replacing any component.

7. System Detector Coverage

7.1 Existing U.S. and international regulations for commercial vessels require automatic fire detection coverage in a wide range of spaces such as corridors, stairways, escape routes from accommodation spaces, RO-RO cargo spaces, and automated machinery spaces.

7.2 It is recommended that each accommodation space have detector coverage, including a detector in each stateroom. Consideration should also be given to placing detectors in other normally unattended areas where a fire may originate.

7.3 In addition to detectors, manually actuated fire alarm boxes must be installed throughout passageways of the accommodation, service, and control spaces and be located at each main exit and stairwell exit. Manually actuated fire alarm boxes are also required in all special category spaces.

8. Zoning

8.1 The fire detection system should be arranged into reasonably sized and clearly identified areas, called zones, to direct responding crew members to the fire's location more quickly. Consideration should be given to having two detection circuits within a zone (that is, area or space). One detection circuit should be dedicated to manually actuated fire alarm boxes and the other dedicated to automatic fire detectors so that alarms can be distinguished from each other. Existing requirements limit individual detection zones as follows:

8.1.1 A zone is limited to a single deck level, except where an enclosed stairway is served by an individual detection zone. This zone can include multiple deck levels. Where the stairway is used as a main egress in the event of a fire, it is recommended that a stairway which joins four or more levels be served by a separate zone.

8.1.2 In passenger ships, separate zones are required on the port and starboard sides of the ship; however, regulations permit exceptions for special cases. Detection zones must be confined horizontally to one main vertical zone (MVZ).

8.1.3 Enclosed automated machinery spaces must be separately zoned from accommodation, service, and control spaces. Multiple small machinery spaces in the same general area may be grouped into a single zone. Clearly identify which connections are to be made to the equipment being monitored.

9. Environmental Effects on Detectors

9.1 Because ships are able to move freely throughout the world, they can be subjected to many different environmental conditions. This makes it very important that the selection process of detectors, control panels, and other alarm system components be made by data and information available from manufacturers and testing laboratories.

9.2 Manufacturers shall be able to provide documentation and certification indicating the effect that environmental conditions such as temperature, humidity, pressure, air velocity, and electromagnetic interference (EMI), including radio frequency (R.F.), transients, corrosives, dust, and vibration, can have on detector sensitivity and performance.

9.3 Testing standards for detectors are usually minimum standards and, therefore, listed detectors are not all equal in performance. For example, smoke detectors may respond to smoke densities ranging from 0.5 to 4 %/ft obscuration. All smoke detectors are marked with their sensitivity. A detector with a 1 %/ft obscuration is more sensitive than a detector set at 3 %/ft. A 3 %/ft obscuration may prove more stable than a detector at 1 %/ft obscuration level. An engineering judgement shall be made as to which sensitivity is more acceptable for which application.

9.4 *Temperature:*

9.4.1 Smoke detectors placed in areas with temperatures approaching the upper or lower limits of the testing laboratory listing will undergo a shift in sensitivity as a result of those temperatures. Detector sensitivities will not shift equally; some detectors will change little and others will change more. The design and quality of the detector can make a difference in performance.

9.4.1.1 Generally, ionization detectors become either more sensitive in colder temperatures or less sensitive in warmer temperatures.

9.4.1.2 Generally, photoelectric detectors become either less sensitive in colder temperatures or more sensitive in warmer temperatures.

9.4.1.3 Flame detectors vary according to individual design. See the manufacturer's information.

9.5 *Relative Humidity* (*RH*)—Relative humidity levels up to 95 % should not affect the performance of most detectors. However, condensate can present a problem to the stability of the detectors. Curves and documentation on the effects of relative humidity can be obtained from manufacturers of detectors.

9.6 *Air Pressure:*

9.6.1 Except for ionization detectors, atmospheric pressures usually have no measurable effect on detector sensitivity. For unusual circumstances, such as submarines or pressure chambers, refer to the manufacturer's data.

9.6.2 Ionization detectors become less sensitive with a decrease in pressure and more sensitive with an increase in pressure. Curves and other documentation on the effects of pressure on detector sensitivity can be obtained from the manufacturer, testing laboratory, or both.

9.7 *Air Velocity:*

9.7.1 Continuous high air velocities or sudden gusts are major factors influencing the stability of some ionization detectors and may cause false alarms or delayed alarms. Curves and documentation on the effects of air velocities on detector sensitivity can be obtained from the manufacturer.

9.7.2 Some detectors use field adjustability to compensate the detector for sensitivity shifts caused by air velocity.

9.7.3 Some detectors use optional air shields to reduce the effects of air velocity on detector sensitivity.

9.7.4 Photoelectric detector sensitivities are not affected by air velocity.

9.8 *Electromagnetic Interference* (*EMI*)—RF energy from sources such as walkie talkies, telephones, and so forth may cause false alarms in ionization and photoelectric detectors. Documentation as to the levels of EMI and at what distances these energies are safe to use around detectors can be obtained from the manufacturer, testing laboratory, or both.

9.9 Other factors influencing the reliability and stability of a detector are as follows:

9.9.1 Unusually high concentrations of vapors from solvents and paints, aerosol sprays, steam, smoke products from kitchens, and tobaccos are some environmental contaminants that may cause false alarms to smoke detectors.

9.9.2 Cigarette lighters, welding, reflection of sunlight, and lightning are some of the environmental conditions that can prove troublesome for UV and IR flame detectors.

9.9.3 In selecting detectors, consideration should be given to the vibration and impact conditions that may occur on board ship. Consult the manufacturer's data.

9.9.4 Location is an important factor in the reliability and stability of a detector. Avoid locating detectors too close to supply air ducts, doorways, and outside elements, that is, exposing detectors to hostile temperatures, wind gusts, and salt spray. Refer to NFPA 72E, Section 5.6, for additional information.

10. Detector Location

10.1 *Type of Detector for Space*—See Table 1.

10.2 *Detector Location Within Space,* general guidance (see NFPA 72E for more detailed instructions):

10.2.1 Determine the maximum detector spacing for smooth, low ceilings and no air flow.

10.2.1.1 Listings or approvals show maximum spacing distance between detectors.

10.2.1.2 Distances are determined by fire tests with prototype detectors.

10.2.2 For rooms over 10 ft (3 m) high, reduce thermal detector spacing according to Table 2. Add intermediate layers of detectors for spaces over 30 ft (9 m) high. For other classifications of detectors, reduced spacing should be considered as vertical height increases. Consult the manufacturer for specific requirements.

10.2.3 To determine the minimum number of detectors, set up a grid of squares using the adjusted maximum spacing with a detector at the center of each square.

10.2.4 Adjust the detector locations to avoid air diffusers, which may blow heat and smoke away from detectors.

10.2.5 Verify that no point in the space is more than 0.7 times the reduced maximum spacing distance horizontally from the nearest detector.

10.2.6 For smoke detectors, the maximum spacing distance between detectors is 30 ft (9 m) before reductions.

10.2.7 Line-of-sight detectors such as flame detectors have a cone-shaped area of coverage emanating from each detector. The protected area must be within the cones of vision. The maximum distance from the protected area to the detector shall not exceed the distance at which a 1-ft^2 (0.0929-m^2) gasoline fire can be detected.

10.2.8 Add appropriate detectors where necessary to assure adequate coverage of high hazard areas or to compensate for obstructions, air flow, and so forth.

10.2.9 Detectors on the overhead should be a minimum of 1.6 ft (0.5 m) away from bulkheads.

11. Alarms

11.1 *Activation of Alarms:*

11.1.1 Visual and audible signals at each control panel and annunciator panel shall be automatically activated upon:

11.1.1.1 Operation of any fire detector.

11.1.1.2 Operation of any manual fire alarm station.

11.1.1.3 Development of a trouble condition in the system.

11.1.1.4 Power supply failure or transfer.

11.1.2 The section or zone in which an alarm or trouble condition occurs shall be indicated visually at the main control panel and at each required annunciator panel.

TABLE 1 Recommended Types of Detectors

NOTE 1—Table 1 indicates the recommended detector for each space. These recommended types are preferred for normal circumstances. The recommended detector should be supplemented by additional types of detectors for specific conditions such as high air flows, potential for rapidly growing fires, unattended operations, and so forth.

Space	Heat	Smoke	Flame	Sampling
Accommodation spaces (including staterooms/quarters)		X		
Passageways, stairways, escape routes, control spaces		X		
Service spaces	X			
Paint lockers	X			
Cargo spaces (with explosives and adjacent space)				X
Cargo spaces (with CO_2 fire extinguishing)				X
RO/RO spaces				X
All other dry cargo spaces	X[A]			
Machinery spaces		X		
Auxiliary machinery spaces	X			

[A] Heat detectors are not necessary if sampling detectors are installed.

TABLE 2 Detector Location and Spacing

Vertical Height, ft (m)		Percent of Listed Spacing
Above	Up To	
0 (0)	10 (3.0)	100
10 (3.0)	12 (3.7)	91
12 (3.7)	14 (4.3)	84
14 (4.3)	16 (4.9)	77
16 (4.9)	18 (5.5)	71
18 (5.5)	20 (6.1)	64
20 (6.1)	22 (6.7)	58
22 (6.7)	24 (7.3)	52
24 (7.3)	26 (7.9)	46
26 (7.9)	28 (8.5)	40
28 (8.5)	30 (9.1)	34

11.1.3 Operation of a fire detector or manual fire alarm station in an automated machinery space shall cause an immediate audible alarm in that space as well as in sufficient other locations to be heard by the responsible engineering officer.

11.1.4 If the above fire alarms are not acknowledged within 2 min, suitable audible alarms shall sound throughout the crew accommodations, service spaces, control spaces, and machinery spaces of Category A. These audible alarms need not be an integral part of the fire detection and alarm system but may be integrated into the general alarm or other approved alarm system.

11.2 *Types of Signalling Devices:*

11.2.1 Alarm signalling devices shall be continuous sounding bells, sirens, horns, or similar devices except that system trouble alarms can be a buzzer or electronically generated signal. In no case should a trouble condition in the fire detection and alarm system initiate a fire alarm signal.

11.2.2 Fire alarm signals shall be distinct from all other alarms in the space in which they are located.

11.2.3 Each signalling device must be identified by a sign with red lettering at least 1 in. (25 mm) high stating "FIRE ALARM."

11.2.4 Fire alarm signals may be transmitted through an approved ship's general alarm system or an approved electrically supervised public address system meeting the standards for fire alarm systems, provided the fire alarm signals are separate and distinct from any other alarm signals.

11.3 *Alarm Signalling Device Location and Spacing:*

11.3.1 At least one fire alarm signalling device is required in each zone or each space containing more than one zone.

11.3.2 In large zones and areas with high ambient noise levels, additional alarm signalling devices shall be provided so that alarms can be heard at any point in the protected zone with all the doors closed.

11.3.3 In areas of high ambient noise levels, flashing or strobe lights must be used to attract attention to the alarm signalling device. This device shall also be labeled "FIRE ALARM" if separate from the alarm signalling device.

11.4 *Manually Actuated Fire Alarm Boxes:*

11.4.1 *Location*—A manually actuated fire alarm box shall be located at each exit from the protected zone in the normal path of exit travel from the zone.

11.4.2 *Travel Distance*—Additional manually actuated fire alarm boxes shall be installed so that no point in a corridor is more than 66 ft (20 m) from a box.

11.4.3 Each manually actuated fire alarm box should be clearly marked as to what the device is, when it should be utilized, and how it should be operated.

11.5 *Control Panel and Remote Annunciator:*

11.5.1 The main control panel shall be located on the bridge or at the fire control station.

11.5.2 If the main control panel is located at the fire control station, a supervised remote annunciator (that is, repeater) shall be located on the bridge. It is recommended that the remote annunciator display the complete system status of the main control panel.

11.5.3 The control panel and required remote annunciators shall visually display the zone of the alarm-initiating device. An instruction chart identifying what to do in the event of an alarm or trouble signal and a graphic layout clearly displaying the zone locations shall be placed on or adjacent to the control panel and required remote annunciators.

11.5.4 Additional remote annunciators may be provided at other locations such as the engine room control station. Additional optional remote annunciators installed in other areas need not display complete systems status nor have supervised wiring.

11.6 *Supplementary Monitoring Functions*—Although the primary function of the control panel is to receive signals from its reporting devices and annunciate them, it may also be used for other fire-related control functions. Selective zone controlled relays can be used to close fire doors, shut down air conditioning or ventilation systems, and other similar functions in the event of a fire. In cases in which the fire detection control panel is approved for sprinkler system monitoring, separate detection circuits are required for the sprinkler system.

11.7 *Power:*

11.7.1 There must be at least two sources of power supply to the fire detection system control panel. When the ship's main and emergency sources of power are used for this purpose, separate feeders are to be wired to an approved power transfer relay at the control panel. When power drops in the main source, the transfer relay shall automatically switch to the emergency source. It shall also automatically switch back to the main source when full voltage is sensed.

11.7.2 A dedicated battery power supply at the control panel is an acceptable second source that may be used in place of the ship's emergency source, provided the batteries are automatically charged and supervised. The battery ampere hour rating shall be capable of powering the fire detection system for a minimum of 36 h on passenger ships and 18 h on other ships and still have sufficient power to energize all alarm devices for 5 min at the end of the required battery operating time.

12. Hazardous Locations

12.1 Equipment installed in hazardous areas shall be specifically approved for hazardous areas.

12.2 All circuits in hazardous areas shall be approved as intrinsically safe or explosion proof.

12.3 The number of types of devices on intrinsically safe circuits may be limited.

13. Equipment and Design Approval

13.1 *Equipment Approval:*

13.1.1 The control panel, detectors, manual boxes, alarms, and other devices connected to the panel shall be tested and approved by a certified organization. The certified organization should be an independent body in the business of testing and approving of fire detection and alarm systems, including quality control, approving, follow-up testing, and labeling of products.