ENGINEERING STANDARD

FOR

AUTOMATIC DETECTORS AND FIRE/GAS ALARM SYSTEMS

ORIGINAL EDITION

MAY 1993

This standard specification is reviewed and updated by the relevant technical committee on Aug. 1998(1) and Dec. 2011(2). The approved modifications are included in the present issue of IPS.

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FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPANY :

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER :

Means the “Company" where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract document.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR :

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR :

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

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1. SCOPE

This Engineering Standard provides minimum general guidelines for design and engineering of fire and gas detection on Iranian Petroleum Industries installations.

This Standard indicates the basic and general requirements of Iranian Petroleum Industries project to be considered by the authorities engineering the projects. This section does not prevail or substitute the regulations and obligations set forward by international standards or National regulations in any manner. The project contractor shall obtain any certificate or guarantees required for safe operation of the plant according to the best work standards.

In selecting Ionized chamber smoke detectors, regulations of Atomic Energy Agency shall be observed. For general guideline on selection and type of Fire/smoke and Thermal detectors reference shall be made to API-PR-550, Part II, Section 10.

Note 1:

This standard specification is reviewed and updated by the relevant technical committee on Aug. 1998. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 39 on Aug. 1998. These modifications are included in the present issue of IPS.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on Dec. 2011. The approved modifications by T.C. were sent to IPS users as amendment No. 2 by circular No. 323 on Dec. 2011. These modifications are included in the present issue of IPS.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

ISO 7240-1	“Fire Detection and Alarm Systems General and Definitions” (1988)
ISO 7731	“Danger Signals for Work Places” (1986)
ISO 7240-1	“Fire Detection and Alarm Systems- Part 1- General and Definitions”

ANSI (AMERICAN NATIONAL STANDARD INSTITUTE)

ANSI/UL 827	“Central Station for Watchman Fire Alarm and Supervisory Services” (1988)
ANSI/UL 268	“Smoke Detectors for Fire Protection Signaling Systems” (1988)
ANSI/UL 217	“Single and Multiple Station Smoke Detectors” (1985)
ANSI/NFPA 92A	“Smoke Control System” (1988)
ANSI/NFPA 72E	“Automatic Fire Detectors” (1987)
ANSI/NFPA 72B	“Auxiliary Protective Signaling Systems for Fire Alarm Services” (1986)

ANSI/NFPA 325M	"Fire Hazards Properties of Flammable Liquids, Gases, Volatile Solids"	(1989)

BSI (BRITISH STANDARDS INSTITUTION)

BSI 5343	"Specification for Short Term Gas Detector Tubes-Part 1"	(1986)
BSI 5445	"Automatic Fire Detection System Parts 1, 5, 7, 8 and 9"	
BSI 5839	"Fire Detection of Alarm Systems for Buildings Parts 1,2,3,4 and 5"	(1988)
BS EN 50073	"Guide for the Selection, Installation, use and Maintenance of Apparatus for the Detection and Measurement of Combustible Gases or Oxygen"	

DIN (DEUTSHES INSTITUT FUR NORMUNG e.v.)

DIN 0575	"Fire Detection Systems"

CEN (EUROPEAN COMMITTEE FOR STANDARDIZATION)

EN 54	"Components of Automatic Fire Detection Systems"
Part 5:	"Heat Sensitive Detectors: Point Detectors Containing a Static Element"
Part 7:	"Point Type Smoke Detectors: Detectors Using Scattered Light, Transmitted Light or Ionization"

API (AMERICAN PETROLEUM INSTITUTE)

API RP-550	"Part II Process Stream Analyzers, Section 10 - Area Safety Monitors"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-GN-100	"Engineering Standard for Units"
IPS-E-EL-110	"Engineering Standard for Electrical Area Classification & Extent"
IPS-E-SF-100	"Engineering Standard for Classification of Fires and Fire Hazard Properties"
IPS-G-SF-310	"General Standard for Gas Detectors"
IPS-G-IN-270	"General Standard for Instruments of Fire and Gas Detection Equipment"

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

NFPA 72 (2007)	"National Fire Alarm Code"

3. DEFINITIONS AND TERMINOLOGY

The terms and words used in this Standard shall be deemed to have the following meanings:

3.1 Accommodation Spaces

Spaces used for public, corridors, lavatories, cabins, praying rooms, offices, cinema, game rooms and pantries.

Public spaces are those portions of the accommodation which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

3.2 Plant Units

The area in which the process plants are installed.

3.3 Service Spaces

Those are used for galleys, pantries containing cooking appliances, lockers, and store rooms, workshops other than those forming part of the machinery spaces and similar spaces and trunks to such spaces.

3.4 Fire and Gas Detection Systems

The combination of fire & gas detection systems including all associated components which connected to emergency shut-down system to detect & alarm of escaped gas, as well as fire to perform pre-defined actions which are necessary to bring the plant/unit to a safe condition.

Detector

A device suitable for connection to a circuit that has a sensor that responds to a physical stimulus such as heat or smoke.

Fire Detectors

Fire detectors are those parts of an automatic fire and gas detection system which continuously monitors suitable physical and/or chemical phenomena for detection of fires in the area under surveillance.

Heat Detector

Detector sensitive to abnormal temperature and/or rate of temperature rise and/or temperature differences.

Rate of Rise Detector

A device that responds when the temperature rises at a rate exceeding a predetermined value.

Fixed Temperature Detector

A device that responds when its operating element becomes heated to a predetermined level.

Linear Heat Detector

A heat detector in which detection is continuous along a path.

Smoke Detector

A detector sensitive to particulate products of combustion and/or pyrolysis suspended in the atmosphere (aerosols).

Ionization Smoke Detector

Detector sensitive to combustion products capable of effecting ionization currents within the detector.

Optical [Photoelectric] Smoke Detector

Detector sensitive to combustion products capable of effecting the absorption or scattering of radiation in the infrared, visible and/or ultraviolet region of the electromagnetic spectrum.

Combination Detector

A device that either responds to more than one of the fire phenomenon or employs more than one operating principle to sense one of these phenomenon. Typical examples are a combination of a heat detector with a smoke detector or a combination rate-of-rise and fixed-temperature heat detector.

Flame Detector

A detector which responds to the radiation emitted by the flames.

3.5 Fire Detection System

Fire detectors and associated control panel to detect and alarm to personnel for evacuation of the plant area and building as well as to indicate the location of the incident to fire brigade to proceed to the scene of the incident (if available).

3.6 Gas Detection

A gas detector is a device which detects the presence of specified gases within an area, usually as part of a safety system.

Toxic Gas Detector (TGD)

A gas detector which is intended for response to presence of specified toxic gases.

Combustible Gas Detector (CGD)

A gas detector which is intended for response to presence of specified combustible gases.

Catalytic Gas Detector

A gas detector, the operation of which depends upon the oxidation of gases on an electrically heated catalytic element.

Manual Alarm Call Point

Device for the manual initiation of an alarm.

3.7 Alarm

A warning of danger. (SIG-FUN)

3.7.1 *Nuisance Alarm.* Any alarm caused by mechanical failure, malfunction, improper installation, or lack of proper maintenance, or any alarm activated by a cause that cannot be determined. (SIG-FUN)

3.8 The Siren

Wherever “the siren” is mentioned in this section, this could mean a number of sirens operated in parallel when required for adequate coverage of extensive premises.

4. UNITS

This Standard is based on International System of Units (SI), as per IPS-E-GN-100 except where otherwise specified.

5. GENERAL REQUIREMENTS FOR FIRE AND GAS DETECTION

The early detection of a developing fire and an early warning to operational and fire fighting personnel form an important aspect in basic concept of fire protection.

Automatic detection is of the utmost importance when immediate action is required, i.e. where products are handled which may ignite spontaneously on leaking to atmosphere. Typical examples are; within the enclosed compartments of gas turbines, at the seal areas of floating roof tanks, in computer and control rooms, and material stores. For other application, reference is to be made to Appendix A.

5.1 Basic Principles

5.1.1 The fire and gas detection systems (FGDS) on an installation are provided to enable the detection of escaped hydrocarbon gas as well as the development of any fire at the earliest possible stage, so that protective measures can be taken before the situation gets out of control.

5.1.2 The system consists of strategically positioned sensors connected to a central panel. The centralized alarm and control systems shall be installed in the nominated control center for the specific area of product movement, jetty control room, building entrances, etc. Slave displays shall be installed for other locations where the occurrence of a fire needs to be known, such as; the general control center, the fire station, the gate-house entrance to the plant or refinery.

5.1.3 Slave displays shall be installed only in centers which are manned 24 hours a day.

5.1.4 The display system shall include all alarm detection and fire protection systems for flammable gas, fire and smoke.

5.1.5 Alarm siren(s) shall be installed which will sound automatically upon activation by push-buttons and fire detection systems. Sirens shall have a range of at least 1.5 km in still air.

5.1.6 As a minimum, all gas detectors and those components of the detection system which are located outdoor and enclosed hazardous area should satisfy the requirements for Division II area as specified in IPS-E-EL-110.

In gas plants and offshore installations where the fire and gas detection system are part of the emergency support system, its components should satisfy the requirements for Division II area as specified in IPS-E-EL-110.

5.1.7 Capacity (As per as Item No. 4.4.1.5.3 NFPA 72-2007)

- Unless otherwise permitted or required by (A) or (B), the secondary power supply shall have sufficient capacity to operate the fire alarm system under quiescent load (system operating in a non alarm condition) for a minimum of 24 hours and, at the end of that period, shall be capable of operating all alarm notification appliances used for evacuation or to direct aid to the location of an emergency for 5 minutes.

(A) The secondary power supply for emergency voice/alarm communications service shall be capable of operating the system under quiescent load for a minimum of 24 hours and

then shall be capable of operating the system during a fire or other emergency condition for a period of 15 minutes at maximum connected load.

(B) The secondary power supply capacity for supervising station facilities and equipment shall be capable of supporting operations for a minimum of 24 hours.

- The secondary power supply capacity required shall include all power supply loads that are not automatically disconnected upon the transfer to secondary power supply. (See also item 6.4.5)

5.1.8 The fire alarm and control system for accommodation and service spaces shall be located in the fire station, if this is permanently manned; where this is not the case, it shall be located in the main control center.

5.2 Alarms and Status Indication for Plant Units

5.2.1 Although the FGDS with associated safety measures are designed to be fully automatic, the presentation of system status to the personnel in the central control room (CCR) is very important. It's vital that operators are immediately brought aware of where a detection has been made. If a fault has occurred in the system it should be detected in which part of the system it has occurred. Status indication should be provided by means of a "mimic"; a simplified layout of the installation indicating for example detection (fire or gas) and fault for the various areas.

5.2.2 Presentation in the CCR should also enable the operator to supervise that correct "chain of events" takes place in case of a detection. This can be provided with a functional matrix where, for each area, the different detections and manual calls, and the operation of the different safety measures are indicated.

5.2.3 There should be a possibility for manual activation of these safety measures from the CCR.

5.2.4 The fire alarm system shall be initiated by;

a) Manual switches (call points) located at strategic points in the plant area, at roadsides, jetties, loading stations, tank farms, etc.;

b) Automatic switches, such as:

- On sprinkler systems;

- Smoke and fire detectors in buildings;

5.3 Buildings, Warehouses and Accommodation Service Spaces Fire Detection and Control Panel

5.3.1 General

All buildings, including warehouses, accommodation spaces and service spaces shall be provided with fire detection and alarm system.

The alarm panel shall be located in fire station or in a permanently manned location, if there is no fire station existing in the plant.

The system shall consist of suitably positioned manual call points, fire and smoke detectors in conjunction with the multi-zone or addressable alarm panel.

5.3.2 Manual call point

5.3.2.1 The manual call points should be located on exit routes, floor landings, exits to open air and possibly other areas depending upon the layout of the building.

5.3.2.2 The distance which a person must travel to raise an alarm should not exceed 30 meters. Obviously the layout of the building could make this considerably less.

5.3.2.3 The standard height for manual call point should be 1.4 meter above the finished ground.

5.3.2.4 The points should, in general, be surface mounted for ease of viewing. If they are semi-flush, then they must have a clearly visible side profile.

5.3.3 Heat detectors

5.3.3.1 Maximum ceiling height for heat detector applications shall be considered as per table 3 and table 4.

5.3.3.2 Maximum area coverage by a single detector shall be considered as per table 3 and table 4.

5.3.3.3 Requirements of BS-5839 Part 1 (1988) shall be considered in design of heat detectors layout.

5.3.4 Smoke detectors

5.3.4.1 Maximum ceiling height for smoke detectors shall be considered as per table 5.

5.3.4.2 Maximum area coverage by a single smoke detector shall be considered as per table 5.

5.3.4.3 Requirements of BS-5839 (1988) shall be considered in preparation of the layout of detectors.

5.3.5 UV/IR flame detectors

5.3.5.1 UV, or combined UV/IR flame detectors shall be used in general area where flame are expected to be one of the prime indications of fire, such as; open outdoor areas, hydrocarbon areas and fuel areas.

5.3.5.2 IR flame detectors shall be used in enclosed areas where the smoke and heat detector limitations do not permit their application.

5.3.5.3 The number and location of flame detectors shall be based on their coverage pattern in a manner that there is no blind corner left undetected.

5.3.6 Audible and visual alarms

When considering the siting and selection of audible and visual alarms, the following points should be considered:

5.3.6.1 In accommodation places where people are asleep, the sound level at behead should be minimally 75 dBA with doors closed. The maximum sound level shall not be in excess of 100 dBA.

5.3.6.2 There should be at least two sounders on a system. At least one audible sounder shall be considered for each zone in a manner to provide sound level at least 5 dB above the surrounding noise.

5.3.6.3 It is normal that a master sounder should be sited in the immediate of the control/indicating equipment.

5.3.6.4 The number, location and type of sounder should be easily distinguished from background and other noise levels, and also should be clearly audible throughout the premises.

5.3.6.5 In plant units, where Noise level does not permit application of sounders, consideration shall be given to visual beacon alarm.

5.3.6.6 In the designation of the areas for multi-zone panels, the following points shall be

considered:

a) The number of floors in the building.

b) The compartment of the floors.

c) Rooms containing high value equipment, such as computers. These areas could also have additional protection such as; fixed extinguishing systems and in some cases can have it's own separate detection system with a simple link to the central fire alarm panel.

d) Stairways should be considered as a separate zone on multi-storey buildings.

e) A single zone on the alarm panel should not cover an area exceeding 2000 m^2.

5.3.6.7 Visual beacon alarm shall be considered for analyzer houses to alarm when purge system has failed. This alarm shall also be activated by fire alarm panel to indicate fire hazard condition.

5.3.6.8 Different type of hazards, such as; toxic/flammable gas concentration or fire shall be indicated in suitable plant area locations by different colors of the beacons installed.

6. FIRE DETECTION SYSTEM

6.1 General Requirements

6.1.1 Fire detectors should, except for fusible plugs, be of a re-settable type such that after activation they can be restored to normal surveillance without the renewal of any components.

6.1.2 Fire detectors connected in loops should further have a visible indication to show that they have been operated. The indication should continue until the loop has been manually reset. If the loop-connected detector which has been operated can be identified from the central control room, there is no need for identification on the detector itself.

6.1.3 The electrical interconnections should be monitored for faults i.e. alarm should be given in case of short circuit, earth fault and open circuit.

6.1.4 Several initiating devices can be wired to one input to give a group alarm in case of any of these devices is actuated (e.g. push-button stations for a group of oil tanks).

Only the first incoming alarm in a group shall give an audible alarm; subsequent alarms in the same group shall be ignored until the alarms have been reset.

Alarms in other groups shall be accepted as first-in coming alarms and give an audible alarm.

6.1.5 The alarm system shall have an input memory, so that momentary alarms are held until acknowledged manually.

6.1.6 The incoming alarms shall automatically:

- operate indicating lamps on the alarm panel;
- operate a claxon in the fire station, control center and any other location specified in the project;
- operate the siren;
- start the fire-fighting pumps (if necessary).

6.2 Selection of Detectors

6.2.1 The selections of detectors for the various areas on an installation should be based on evaluation of the prime fire indications and ambient conditions.

6.2.2 A fire development in a process or wellhead area is likely to be associated with flammable fluids and have a fast development. The prime indications of a fire in such areas will be flames and a high heat output. A fire development in a switchgear or control room will typically be caused by overheating of insulation in electrical components and give rise to a very slow fire development

initially characterized by invisible products of combustion. The choice of fire detectors for an area must reflect the anticipated prime indications of a fire under development.

6.2.3 The second aspect which should be considered is the ambient conditions in the various areas under which the detectors will have to operate. This will involve evaluation of natural environmental conditions such as wind, temperature, solar radiation, salinity, humidity, as well as industrial conditions such as dust, oily atmosphere, vibration, etc.

These conditions will impose restrictions in the choice and effectiveness of the detectors and also on the operation and maintenance requirements.

6.2.4 Table 1 lists some commonly used detector types with their characteristics, application and environmental resistance.

TABLE 1 - FIRE DETECTOR PARAMETERS AND APPLICATIONS

Features / Detector Type	Advantages	Disadvantages	Application	Environmental Resistance
Ultraviolet flame - Detectors	- Fast response - Large coverage - Unaffected by wind	- Need a straight " line of sight " - Ultraviolet radiation absorbed by heavy smoke	- In general areas where flames are expected to be one of the prime indications of fire. - Hydrocarbon areas and fuel areas - Open outdoor areas	- Very good. - Unaffected by rain, wind etc. - Solar blind if sensitivity below 2800
Ultraviolet flame - Detectors	- Fast response - Large coverage - Unaffected by wind - Infrared radiation not absorbed by smoke	- Need a straight " line of sight " - Radiation from sun and hot vibratory machinery may give rise to false alarms	As for UV, however, not recommended in outdoor areas and areas where vibrating machinery operates	- Good. - Unaffected by rain, wind etc. Solar radiation may give rise to false alarms
Heat - Detectors	- Reliable	- Relatively slow response	1. General areas where ambient conditions are too rough for smoke detectors. 2. As back-up for flame detectors in high hazard areas.	- Good, although response affected by wind is making them less suitable for open outdoor areas.
Smoke detectors	- Very sensitive - Detect smoldering fires at early stage	Require relatively clean atmosphere	- General clean areas not associated with flammables - Control room - Switchgear room - Void spaces behind false floors and ceilings. - Accommodation	- Not suitable for open outdoor areas or naturally ventilated areas.

6.2.5 For major hazard areas two different detection principles should be used. This is indicated in Table 2 which gives a guideline for the choice of detectors for some typical platform areas.

For other areas, two different detection principles should be used where a fire will develop with different characteristics.

TABLE 2 - GUIDELINE FOR THE CHOICE OF FIRE DETECTORS IN SOME TYPICAL PLATFORM AREAS

	AREA	PRIMARY DETECTION	SECONDARY DETECTION
1)	MAJOR HAZARD AREAS		HEAT
	WELHEAD		HEAT
	PROCESS AREAS INC.:	FLAME	
	MANIFOLDS, SEPARATORS, COMPRESSORS, ETC.	FLAME	
2)	OTHER		
	MUD PROCESSING	FLAME/HEAT	
	FUEL OIL STORAGE	FLAME/HEAT	
	TURBINE/GENERATOR AREA	SMOKE/HEAT	
	UNDER TURBINE HOOD	FLAME/HEAT	
	DIESEL GENERATOR ROOM	FLAME/HEAT/SMOKE	
	WORKSHOP	HEAT (SPRINKLER)	
	CONTROL ROOM	SMOKE	
	BATTERY ROOM	SMOKE/HEAT	
	CEILING/FLOOR VOID 0.8 m.	SMOKE	
	SWITCHGEAR ROOM	SMOKE	
3)	QUARTER		
	CABINS	SMOKE/HEAT (SPRINKLER)	
	CORRIDORS	SMOKE/HEAT (SPRINKLER)	
	PUBLIC ROOMS	SMOKE/HEAT (SPRINKLER)	
	RADIO ROOMS	SMOKE	
	GALLEY	HEAT	
	GALLEY HOOD/DUCT	HEAT (FIXED TEMPERATURE)	
	LAUNDRY	SMOKE/HEAT (SPRINKLER)	
	WASHROOMS/WC'S	HEAT (SPRINKLER)	
	STAIRCASES	SMOKE	

6.3 Detector Layout

6.3.1 When it is decided upon which types of detectors are to be employed in the various areas, the next task should be the location of individual detectors. Final positioning should be decided on site after equipment, pipes, ventilation ducts etc., have been installed. The number of detectors and their layout should be decided upon at design stage.

6.3.2 Performance of heat and smoke detectors should be in accordance with European Standard EN 54-5 and -7 respectively. The Tables 3, 4 and 5 should be used as guidance in the spacing layout of the detectors.

6.3.3 All detectors for process area applications shall be considered to be explosion-proof for class I, Division 1, Groups A, B, C, and D (See IPS-E-SF-100).

TABLE 3 - LIMITS FOR SITING POINT TYPE HEAT DETECTORS IN OPEN AREAS, NATURALLY VENTILATED

Max. FLOOR AREA TO BE COVERED BY ONE DETECTOR (m^2)	Max. DISTANCE BETWEEN DETECTOR CENTERS (m)	Max. DISTANCE AWAY FROM ANY BULKHEAD (1) (m)	CEILING HEIGHTS, HIGHER LIMIT (2) (m)
25	7	3.5	4 to 7

1) Detectors should not be mounted less than 0.5 m away from any outside wall or dividing partition. This should be applied for detectors mounted adjacent to bulkheads.

2) For fast response detector, maximum ceiling height limit is 7 m.

For slow response detector, maximum ceiling height limit is 4 m.

TABLE 4 - LIMITS FOR SITING POINT TYPE HEAT DETECTORS IN ENCLOSED AREA, MECHANICALLY VENTILATED

Max. FLOOR AREA TO BE COVERED BY ONE DETECTOR (m^2)	Max. DISTANCE BETWEEN DETECTOR CENTERS (m)	Max. DISTANCE AWAY FROM ANY BULKHEAD (1) (m)	CEILING HEIGHTS, HIGHER LIMIT (m)
37	9	4.5	5.5 - 8.5

1) Detectors should not be mounted less than 0.5 m away from any outside wall or dividing partition. This should be applied for detectors mounted adjacent to bulkheads.

2) For fast response detector, ceiling height limit is 8.5 m.

For slow response detector, ceiling height limit is 5.5 m.

TABLE 5 - LIMITS FOR SITING POINT TYPE SMOKE DETECTORS IN ENCLOSED AREAS

Max. FLOOR AREA TO BE COVERED BY ONE DETECTOR (m^2)	Max. DISTANCE BETWEEN DETECTOR CENTERS (m)	Max. DISTANCE AWAY FROM ANY BULKHEAD (1) (m)	CEILING HEIGHTS, HIGHER LIMIT (m)
50	10	5	7.5

1) Detectors should not be mounted less than 0.5 m away from any outside wall or dividing partition. This should be applied for detectors mounted adjacent to bulkheads.

6.3.4 The siting should also take account of intensity and pattern of ventilation to ensure that the fire signature from a developing fire will reach the detector. The detectors should be located clear of beams and other features likely to shield the detectors. “Smoke” tests with equipment and ventilation running should be carried out at commissioning stage to verify adequate location.

6.3.5 Fire detectors should be suitably protected against physical damage caused by normal activity in an area. The accessibility of the detectors should be satisfactory with respect to maintenance.

6.3.6 Where detectors are located behind panels, in false ceilings/floor, voids or in other invisible locations, a remote fire indication showing the operation of the detectors should be arranged in an adjacent area normally occupied i.e. corridor, hall, general area, etc.

6.4 System Configuration

6.4.1 Based upon fire detection, certain safety measures are often initiated. Keeping in mind that fire detectors do no respond to fire as such, but rather to certain characteristics commonly associated with fire (i.e. smoke, heat, radiation), it is unavoidable that some nuisance activation of sensors will take place. This because the mentioned characteristics, is also present during normal operating conditions with varying frequency and intensity, due to other events than fire.

6.4.2 To safeguard against initiation of safety measures on a false basis it is common to require two fire detectors to operate before this is initiated e.g. "2-out-of 3" which implies that with a group of three detectors a signal from any two will initiate a safety function. Signal from any one should always give alarm. It is important with such systems that the detectors involved are located such that both will sense the fire development sufficiently fast to enable the safety measures to be initiated before the fire has developed to a critical level. A "2-out-of 2" voting system shall not be considered as this implies reduced availability.

6.4.3 The safety actions to be initiated depend on the type of area where the detection has been made. The following are examples of typical actions which should be initiated as applicable to the particular area:

- Fire alarm to be activated in central control room and areas influenced by the fire.
- The flow of hydrocarbon to and from the area where the detection has been made to be shut down.
- Mechanical ventilation to the area where the fire has been detected to be shut down and fire dampers to be closed.
- Fixed fire extinguishing system to be activated.
- Fuel supply to fired units to be shut down (except prime movers for emergency equipment).

6.4.4 Alarm panel

6.4.4.1 The alarm panel shall have indicating lamps for;

- Individual alarms,
- Group alarms,
- Power "on",
- System faults such as; electricity supply failure, over-current, low battery voltage, system failure.

6.4.4.2 The panel shall have operating controls;

- On/off (per group),
- Test (simulating alarm condition),
- Cancel the audible alarm,
- Reset the system (clear input memory).

6.4.4.3 When the alarm and control panels are located in the fire station, consideration should be given to the use of the typical fire alarm systems available commercially. The control panel shall match the size and appearance of the alarm panel. The complete alarm and pertinent control system, together with logic circuitry and electricity supply, shall preferably be arranged in one cubicle or cabinet.

6.4.4.4 When the alarm and control panels are located in the control room, preference should be given to a design matching other alarm/control systems in the control room. The logic circuitry and electricity supply shall then be accommodated in the auxiliary room.

6.4.5 Capacity (As per as Item No. 4.4.1.5.3 NFPA 72-2007)

- Unless otherwise permitted or required by (A) or (B), the secondary power supply shall have sufficient capacity to operate the fire alarm system under quiescent load (system operating in a non alarm condition) for a minimum of 24 hours and, at the end of that period, shall be capable of operating all alarm notification appliances used for evacuation or to direct aid to the location of an emergency for 5 minutes.

  (A) The secondary power supply for emergency voice/alarm communications service shall be capable of operating the system under quiescent load for a minimum of 24 hours and then shall be capable of operating the system during a fire or other emergency condition for a period of 15 minutes at maximum connected load.

  (B) The secondary power supply capacity for supervising station facilities and equipment shall be capable of supporting operations for a minimum of 24 hours.

- The secondary power supply capacity required shall include all power supply loads that are not automatically disconnected upon the transfer to secondary power supply.

6.5 Control System

6.5.1 General

6.5.1.1 The fire alarm and control system shall comprise of an alarm system and a control system.

6.5.1.2 The location of the alarm and control panel shall be in the fire station or in the central control room (see 5.1.8)

6.5.1.3 The control of fire fighting systems for control rooms and digital computers is not covered herein and shall be specified by the vendors.

6.5.2 System operation

The control system shall be suitable for:

- Automatic and manual starting of alarm siren (see 6.5.3).

6.5.3 Siren control

6.5.3.1 The siren shall be started automatically in case of a fire alarm, or by means of a "Fire" push-button on the control panel. The siren shall then operate intermittently for a period of 30-100 seconds, with an ON time of 5-8 seconds and an OFF time of 3-5 seconds (adjustable).

7. GAS DETECTION SYSTEM

7.1 General Requirements

7.1.1 The principle use for gas detection on fixed offshore installations and gas processing plants is normally that of catalytic combustion. This principle associates with particular advantages and disadvantages which should be appreciated in the design and installation of the system.

7.1.2 An advantage is that this type of measurement is very direct; it measures flammability directly by an exotherm oxidation on the sensor element, the heat of oxidation being directly proportional to the percentage of LEL (Lower Explosion Limit) existing at the sensor head. This measuring principle

does not easily give rise to nuisance alarms as only the presence of flammable gas on the sensor element normally causes the detector to be activated. A disadvantage with this measuring principle is the inherent non-fail-safe mode, i.e. that on loss of sensitivity, which is the most experienced and probable failure for these detectors, no alarm is given. The only way to demonstrate satisfactory performance of such sensors is to expose them to a concentration of gas (e.g. 50% LEL) and read off the response.

7.1.3 The electrical connections should be monitored as for fire detection systems; i.e. fault alarm should be given in case of open circuit, short circuit and earth fault.

7.1.4 At least two adjustable alarm levels (e.g. set to 20% and 60% LEL) should be provided with independent voltage free, contact outputs.

It should be possible to test the alarm levels from the control unit by simple means, such as local miniature switch.

7.2 Detectors Layout

7.2.1 The location of detectors should reflect a combination of two philosophies. Primarily the gas should be detected near the probable sources of leakage. This implies that gas detectors should be installed in hazardous areas and ventilation outlets from mechanically hazardous areas.

Secondly any gas approaching areas where possible ignition sources are located should be detected. Such areas are utility areas where e.g. nonexplosion protected electrical equipment, combustion engines etc. are located . This implies that gas detectors should be located in ventilation inlets to non-hazardous areas and in combustion air inlets.

7.2.2 The layout of gas detectors should not be precisely determined before major equipment, pipes and ducts are installed. Full effect should be taken of the ventilation pattern and the normal ambient conditions at the various locations.

7.2.3 Consideration should be given to the molecular weight of the gas mixture in the various parts of the process, and whether a lighter or heavier-than-air gas leak would result in case of a leakage.

7.2.4 Weather protection covers should be employed in areas as recommended by the manufacturer. An evaluation of the influence on the response time caused by such accessories should be considered.

7.2.5 The access for maintenance is particularly important for gas detectors as being an instrument system heavily dependent upon proper testing and maintenance.

7.3 Poisoning of Catalytic Gas Detectors

7.3.1 A problem to be aware of with catalytic gas detection system is the phenomenon of catalyst poisoning. This implies that the sensing element becomes desensitized in the presence of small quantities of certain chemical substances in the atmosphere. Permanent loss of sensitivity will generally be caused by compound containing silicones or heavy metals such as lead, copper and zinc.

7.3.2 The following considerations should be related to the poisoning problem:

- **a)** Be aware of the compounds which are liable catalyst poisons (consult the manufacturer) and try to limit their use. Non-poisonous alternatives are often available.
- **b)** Make use of protective filters (e.g. carbon-or ceramic filters) in "problem areas" i.e. areas where a poisonous atmosphere is unavoidable.
- **c)** Redundancy, see 7.4.

7.4 System Configuration

7.4.1 The use of a voting principle for gas detectors, as described in 6.4.2 for fire detectors, should be carefully evaluated due to the non-fail safe mode of gas detectors. In case a " 2 out of 3" voting principle is used, it should be ensured that all the detectors within a group can sense the same gas leakage. Normally, the distance between any two detectors working in coincidence should not be more than 3 meters. A "2 out of 2" voting system should be avoided.

7.4.2 The safety actions to be initiated upon gas detection in an area should be as follows :

- All flow of hydrocarbons to and from the actual area to be shut down.
- All potential ignition sources in the area to be eliminated.

7.4.3 In case of max. 50% LEL gas detection in a ventilation intake, the following actions should take place;

- The ventilation fan to be stopped,
- The fire damper to be closed,
- The heating element to be shut off,
- All ignition sources within the space being ventilated to be eliminated.

7.4.4 In case of max. 50% LEL gas detection in combustion air intakes, the machinery should be stopped. Prime movers for fire pumps are excepted from this.

7.4.5 For turbines, shut down should be effected at considerably lower gas concentration at the combustion air intake. Shut down at 15-25% LEL is often recommended. Turbine manufacturers should be consulted.

8. ALARM SYSTEM

8.1 Alarms and Status Indication for Plant Units

8.1.1 Although the FGDS with associated safety measures are designed to be fully automatic, the presentation of system status to the personnel in the central control room (CCR) is very important. It’s vital that operators are immediately brought aware of where a detection has been made. If a fault has occurred in the system it should be detected in which part of the system it has occurred. Status indication should be provided by means of a "mimic"; a simplified layout of the installation indicating for example detection (fire or gas) and fault for the various areas.

8.1.2 Presentation in the CCR should also enable the operator to supervise that correct "chain of events" takes place in case of a detection. This can be provided with a functional matrix where, for each area, the different detections and manual calls, and the operation of the different safety measures are indicated.

8.1.3 There should be a possibility for manual activation of these safety measures from the CCR.

8.1.4 The fire alarm system shall be initiated by;

a) Manual switches (call points) located at strategic points in the plant area, at roadsides, jetties, loading stations, tank farms, etc.;

b) Automatic switches, such as:

- On sprinkler systems;
- Smoke and fire detectors in buildings;

8.2 Audible and Visual Alarms

When considering the siting and selection of audible and visual alarms, the following points should be considered:

8.2.1 In accommodation places where people are asleep, the sound level at behead should be minimally 75 dBA with doors closed. The maximum sound level shall not be in excess of 100 dBA.

8.2.2 There should be at least two sounders on a system. At least one audible sounder shall be considered for each zone in a manner to provide sound level at least 5 dB above the surrounding noise.

8.2.3 It is normal that a master sounder should be sited in the immediate of the control/indicating equipment.

8.2.4 The number, location and type of sounder should be easily distinguished from background and other noise levels, and also should be clearly audible throughout the premises.

8.2.5 In plant units, where Noise level does not permit application of sounders, consideration shall be given to visual beacon alarm.

8.2.6 In the designation of the areas for multi-zone panels, the following points shall be considered:

a) The number of floors in the building.

b) The compartment of the floors.

c) Rooms containing high value equipment, such as computers. These areas could also have additional protection such as; fixed extinguishing systems and in some cases can have it's own separate detection system with a simple link to the central fire alarm panel.

d) Stairways should be considered as a separate zone on multi-storey buildings.

e) A single zone on the alarm panel should not cover an area exceeding 2000 m^2.

8.2.7 Visual beacon alarm shall be considered for analyzer houses to alarm when purge system has failed. This alarm shall also be activated by fire alarm panel to indicate fire hazard condition.

8.2.8 Different type of hazards, such as; toxic/flammable gas concentration or fire shall be indicated in suitable plant area locations by different colors of the beacons installed.

APPENDICES

APPENDIX A

TYPICAL APPLICATIONS FOR FIRE, SMOKE AND FLAMMABLE GAS DETECTION

AREAS OF APPLICATION		DETECTION TYPE					GAS	REMARKS
		FLAME	LINEAR HEAT	SPOT HEAT	SPOT SMOKE	AREA SMOKE		
1)	FLOATING ROOF TANK RIM AREA		X	X				HEAT SENSITIVE TUBING/ QUART-ZOID BULBS
2)	SELECTED HYDROCARBON PUMPS		X					HEAT SENSITIVE TUBING
3)	SELECTED AREAS OR EQUIPMENT HOLDING HYDROCARBONS		X					HEAT SENSITIVE TUBING
4)	ANALYSER HOUSE						X	
5)	GAS TURBINE/GAS COMPRESSOR IN ENCLOSURES	X		X			X	RATE OF RISE HEAT DETECTION
6)	PLANT LABORATORY			(X)	X			
7)	MAIN LABORATORY			(X)	X			
8)	INSTRUMENT AUXILIARY ROOM CABINETS, FLOOR CAVITY, CABLE ROUTES					X		COMBINED HCL SMOKE DETECTION
9)	COMPUTER AUXILIARY ROOM					X		COMBINED HCL SMOKE DETECTION
10)	COMPUTER OPERATION ROOM			(X)	X			
11)	BATTERY ROOM			X				*
12)	LPG BOTTLE FILLING PLANT			X			X	PLANT/AREA
13)	WORKSHOP-GENERAL			(X)	X			
14)	WORKHOUSE PROCESS ANALYSERS				X		X	
15)	WAREHOUSE-GENERAL			(X)	X			
16)	WAREHOUSE-LPG STORAGE			X			X	
17)	WAREHOUSE-HYDROCARBONS		X					
18)	ADMINISTRATION BUILDINGS			(X)	X			
19)	TELEPHONE EXCHANGE/RADIO ROOM			(X)	X			
20)	CANTEEN				X			
21)	KITCHEN AREA			X				
22)	TRAINING CENTER				X			
23)	FIRE STATION			(X)	X			
24)	GARAGE			(X)	X			
25)	LNG CONTAINMENT AREA						X	ALSO WITH LOW TEMPE-RATURE DETECTION
26)	TRANSFORMER ROOM		(X)					

Note:

- **Spot smoke detectors should be of the integral heat detection type where indicated thus -(X).**
- **Gas Detectors may be flammable. Gas Detectors or Toxic Gas Detectors (TGD) or combination of them, shall be selected according to the nature of the process.**

*** H2 Gas Detector shall be used for electrolyte batteries.**