IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, August 2026
Impact Factor: 8.2

Hazard Identification and Fire Risk Evaluation through Advanced Detection System Installations in LPG Bottling Plants

Jitendra Patlya[1] and Prof. Neeta Banger[2]
[1]M.Tech. Scholar, [2]Professor
Department of Fire and Safety
Shiv Kumar Singh Institute of Technology and Science, Indore, (RGPV) Madhya Pradesh, India

Abstract: *Industrial facilities, particularly those handling Liquefied Petroleum Gas (LPG) and other volatile petrochemicals, are highly susceptible to catastrophic fire and explosion hazards. The rapid escalation and destructive totality of such incidents necessitate the deployment of robust and highly responsive active fire detection and alarm systems to mitigate risks to human life, property, and the environment. This dissertation comprehensively investigates the design, installation, and optimization of active fire and gas detection systems specifically tailored for LPG workplace environments, including bullet storage, Horton spheres, and mounded storage facilities. The primary objective is to formulate a cohesive safety framework that ensures rapid anomaly detection while significantly minimizing the occurrence of false alarms—a prevalent issue that severely compromises system credibility, increases operational costs, and induces organizational disruption.*

The study involves a detailed technical analysis of various detection methodologies, including ionization and optical smoke detectors, fixed-temperature and rate-of-rise heat detectors, multi-sensor systems, and infrared/ultraviolet flame detectors. A quantitative assessment is conducted to determine the optimal configuration, spacing, and siting of these sensors based on the specific geometry and hazard profile of different LPG storage vessels. The research highlights the strategic placement of heat detectors encircling storage vessels and gas detectors positioned near Remote Operated Valves (ROVs) and inspection tunnels to ensure maximum coverage and early warning capabilities. Furthermore, a detailed cost-estimation model for the complete installation of a fire detection and alarm system—encompassing control panels, manual call points (MCPs), and notification appliances—is presented to demonstrate the financial feasibility and critical necessity of such safety investments.

A significant portion of the research explicitly addresses the problem domain of false alarms. The study systematically identifies primary causes, such as environmental factors, inappropriate sensor placement, equipment faults, and human error, and proposes targeted mitigation strategies. These strategies include the implementation of sensitivity-floating detection systems, multi-stage alarms, application of pattern recognition methods, and adherence to stringent, routine maintenance protocols. The findings establish that the integration of strategically positioned, application-specific detection systems profoundly enhances the safety integrity of LPG plants. By strictly adhering to national and international safety standards (such as NFPA 72, IS-2189, and OISD guidelines) and adopting advanced false-alarm correction methodologies, industrial facilities can achieve a highly reliable, early-warning fire protection mechanism that guarantees swift emergency response and continuous systemic risk reduction.

Keywords: Active Fire Protection system, Fire Hazards, LPG Storage area, Alarm system, Fire detectors, storage facilities

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, August 2026
Impact Factor: 8.2

I. INTRODUCTION

For any industry to be successful it should meet not only the production requirements, but also maintain the highest safety standards for all concerned. The industry has to identify all the possible fire hazard and its related components to prevent the loss of life and property caused due to fire. 'Oil refinery' is a plant where crude oil is received and processed to produce various intermediates and finished products. Such as- LPG, Naphtha, High Speed Diesel, Motor Spirit, Superior Kerosene Oil, Low Sulphur, Raw Petroleum Coke Etc. These products possess potential of great fire hazard which forms the platform for developing good fire protection facilities to prevent the outbreak of fire.

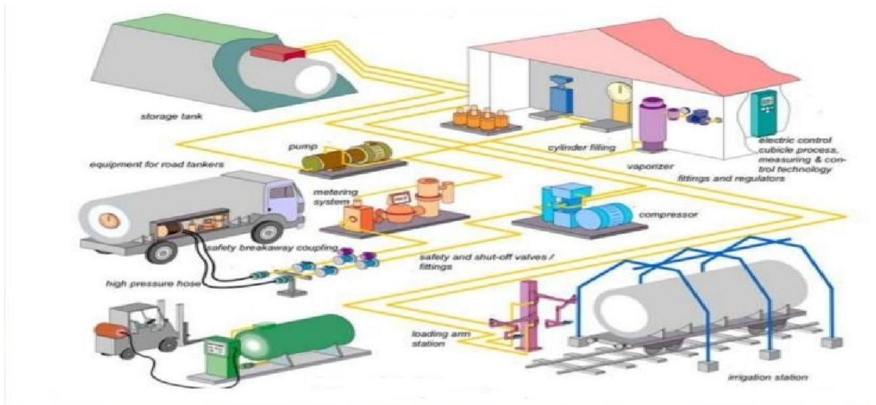

Figure 1.1 oil Refinery overview

Many fires are not discovered in their early stages by occupants of the premises involved but are revealed only when they have developed sufficiently to become noticeable and considerable damage. Such delays in fires being discovered and further delay in calling fire brigade are major factors contributing to heavy fire losses.

Need Of Fire Detection And Alarm System

Industrial fire detection and alarm systems are designed to:

• Detect fires

• Initiate alarms (locally and, for some facilities, off-site)

• Activate fire isolation devices and/or fire suppression systems (and, for some systems, activate or shut down equipment).

Irrespective of any structure, a fire alarm system duly designed, manufactured, installed, tested and maintained can help limit property losses in structures from fire, at the same time to significantly reduce the loss of lives from the fire. The activation mechanism of the detection system may be automatic detection devices or by manual operation of the call points.

Objectives

Keeping the aforementioned problem in mind, the project work has been planned with the following objectives –

• Describe the purpose and importance of industrial fire detection and alarm systems.

• Describe operator and maintenance personnel responsibilities for the fire detection and alarm system.

• Describe fire zones.

• Describe fire detection and alarm system components and ancillary devices.

• Describe four types of fire detector.

• Describe two types of central control units.

• Describe Stage 1 and Stage 2 fire alarms.

• Describe fire detection alarm system inspection and testing.

• Describe limitations of fire detection and alarm systems.

II. LITERATURE REVIEW

2.1 The following is the brief review of the work carried out by researchers in the field of "Fire detection and alarm system"

S Ramesh, P Kumar (2024) had done research on Fire Alarm System Based on Multi-Sensor Bayes Network- Aimed at the problem of false alarm and missing alarm caused by information uncertainty existing in the fire alarm system, Bayesian network (BN) is proposed to analyse fire alarm System. The paper elaborates the internal logic relationship between the fire alarm and the physical-chemical characteristics generated in the process of fire burning by analyzing fire mechanism. Based on defining node variables in BN, multi-sensor Bayesian network model for the fire alarm system is established in Netica. Probabilistic inference and sensitivity analysis of finding node verified that analyzing fire probability through the multi-sensor Bayesian network model is feasible and effective.

R S Chatopikar, Prashant Deshmukh (2023) proposed an effective four-stage smoke-detection algorithm using video images for early fire-alarm systems –This paper proposes an effective, four-stage smoke-detection algorithm using video images. In the first stage, an approximate median method is used to segment moving regions in a video frame. In the second stage, a fuzzy c- means (FCM) method is used to cluster candidate smoke regions from these moving regions. In the third phase, a parameter extraction method is used to extract a set of parameters from spatial and temporal characteristics of the candidate smoke regions; these parameters include the motion vector, surface roughness and area randomness of smoke. In the fourth stage, the parameters extracted from the third stage are used as input feature vectors to train a support vector machine (SVM) classifier, which is then used by the smoke alarm to make a decision. Experimental results show that the proposed four-stage smoke-detection algorithm outperforms conventional smoke-detection algorithms in terms of accuracy of smoke detection, providing a low false-alarm rate and high reliability in open and large spaces.

H.C. Kuo, H.K. Chang (2021) Proposed a real time shipboard fire detection system based on grey-fuzzy algorithms – To improve on the performance of traditional ship fire alarm systems, this paper investigates a dual-sensor device employing a grey-fuzzy algorithm. The theoretical aspects of the device and its experimental evaluation are presented. In terms of the algorithm, first an adaptive fuzzy classification system with an automatically generated rule base is developed for accurate fire-detection response to the output of a sensor pair (one temperature K-type thermocouple and one analog photoelectric smoke detector). Second, two alternative grey GM(1,1) prediction models are developed for anticipating trends in real-time temperature and smoke data, thus allowing early fire warning. Finally, the fuzzy system is combined with the grey-prediction algorithms for final testing. In the engine room of a docked coastal fishing trawler, two experimentally controlled fires are created, one open flame and one smouldering, and results from the sensor pair are recorded. As-detected results for each fire are processed by computer which tests the response behaviour of the alternative fuzzy-grey options and selects the optimal options set, and also compares the dual-sensor pair as conventionally operated in a commercial detector. Results indicate grey-fuzzy algorithms combining fuzzy rule-based classification and grey GM(1,1) unified-dimensional new message modeling are feasible in real-time shipboard fire detection, allowing accurate fire alarm triggering from 30 to 60 s earlier than conventional methodology.

CHENG Caixia and SUN Fuchun, (2021) had worked on one Fire Detection Method Using Neural Networks – A neural network fire detection method was developed using detection information for temperature, smoke density, and CO concentration to determine the probability of three representative fire conditions. The method overcomes the shortcomings of domestic fire alarm systems using single sensor information. Test results show that the identification error rates for fires, smouldering fires, and no fire are less than 5%, which greatly reduces leak-check rates and false alarms. This neural network fire alarm system can fuse a variety of sensor data and improve the ability of systems to adapt in the environment and accurately predict fires, which has great significance for life and property safety.

2.2 Literature gap

Theme / Research Aspect	Existing Literature Focus	Identified Research Gap
Post-Incident Response vs. Pre-Emptive Detection	General open-space smoke and video detection algorithms (e.g., Chen Jing, Truong Xuan Tung).	Lack of targeted research on localized, instantaneous early-warning systems for catastrophic failure points (e.g., ROVs, nozzle domes) to prevent BLEVE.
Sensor Application in Harsh Environments	Software algorithms (Neural Networks, SVM) for conventional single-threshold detectors.	Inadequate focus on the physical misapplication and environmental vulnerability of hardware in high-hazard LPG bottling plants, leading to alarm fatigue.
False Alarm Mitigation Strategy	Sensor fusion to reduce false alarms, often generalizing specific industrial triggers (welding fumes, exhaust, steam).	Critical need for a comprehensive framework integrating HIRA and FTA directly into the physical placement and sensitivity calibration of the detection architecture.
Geometrical Modeling & Cost Analysis	Purely focused on detection accuracy and computational/algorithmic efficiency.	Scarcity of practical, geometrical models for optimal detector siting around specific LPG vessels (Bullets, Horton Spheres, Mounded Storage) combined with real-world cost-estimation.

Table 2.1: Literature gap

III. SYSTEM DOMAIN

1 Fire Alarm System

An automatic fire alarm system is designed to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. In general, a fire alarm system is classified as either automatically actuated, manually actuated, or both. Automatic fire alarm systems are intended to notify the building occupants to evacuate in the event of a fire or other emergency, report the event to an off-premises location in order to summon emergency services, and to prepare the structure and associated systems to control the spread of fire and smoke.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, August 2026
Impact Factor: 8.2

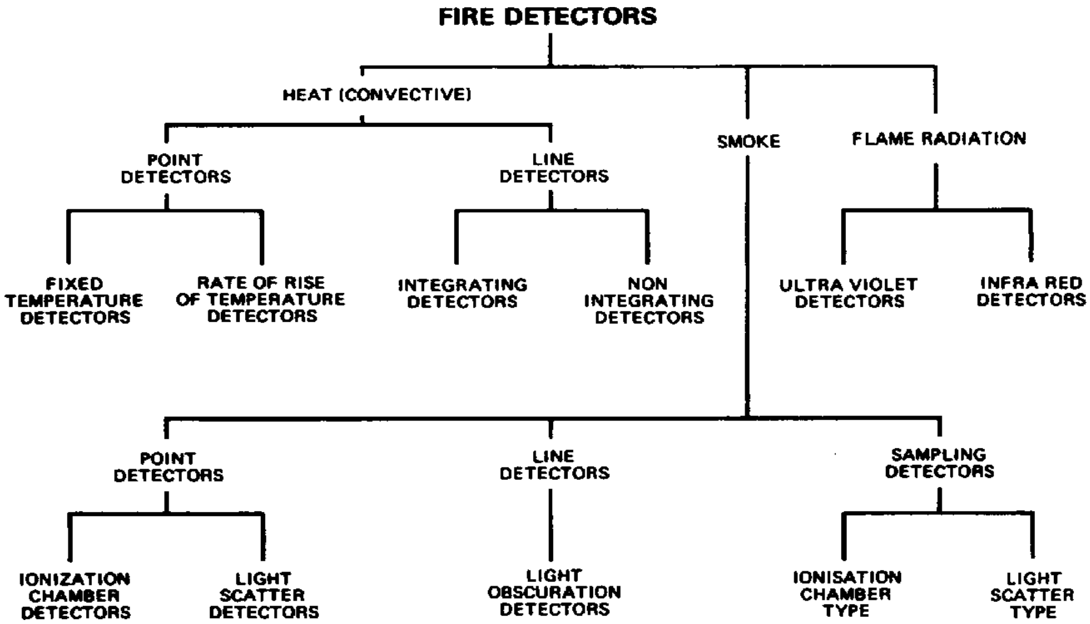

Figure 3.1: Fire detection system

Alarm System: "An alarm system is an audible and /or visible means of indicating to the operator an equipment malfunction process deviation, or abnormal condition requiring a response." Strictly adhering to the requirements of NFPA 72, National Fire Alarm Code is fundamental to maintaining an appropriate level of quality control through the steps that lead to the successful provision of a fire detection and alarm system. This document, working in concert with NFPA 70, National Electrical Code, particularly Article 760 on wiring for fire alarm systems, forms the basis for requirements that have been created through the consensus standards-making process. These requirements represent the combined experience and professional judgment of the members of the eight technical committees that write the various chapters of NFPA 72.

The design and installation of electrical fire alarm system are also covered by BS 3116 part 4 and BS 5836 part 1.

(A) Selecting The System

In making the basic decision regarding what type of fire alarm system is needed for a particular building, certain questions must be answered. In answering these questions, one must bear in mind that the most successful approach to the overall protection of life and property is a holistic approach—an approach that relies on the fact that the protection provided by the sum of the individual components of the fire protection system will always be much greater than if one was to rely on each individual component alone. Thus, effective protection is a combination of interlocking, interrelated fire protection systems, designed to function in concert with each other to provide the desired level. It is not a matter of whether or not automatic sprinklers or a fire alarm system should be provided. Rather, automatic sprinklers, a fire alarm system, and proper building construction features such as fire cutoffs along with a host of other valuable prevention and protection features, all built on a foundation of management commitment to fire prevention and control, can assure a building owner or occupant that a facility is safe.

Making The System Work

Just as building fire protection is most effective when it consists of a series of interlocking, interrelated fire protection systems, ensuring the mission effectiveness of a fire alarm system is the result of specific attention given to a series of interlocking, interrelated steps:

• Specify
• Design

DOI: 10.48175/IJARSCT-38027

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, August 2026
Impact Factor: 8.2

• Manufacture
• Maintain
• Test
• Install

Types Of Signals

Fire alarm systems may provide three types of signals:

•Alarm
•Supervisory
•Trouble

An alarm signals a warning of fire danger that requires immediate action. A supervisory signal indicates that action is needed in connection with the operation of other fire protection systems that are being monitored by the fire alarm system. Such systems may include extinguishing or suppression systems, such as automatic sprinkler systems, carbon dioxide systems, dry chemical systems, foam systems, and gaseous agent systems. They may also include the supervision of guards who make fire patrol tours throughout the protected premises. A supervisory signal may be either an "off-normal" signal, indicating a condition requiring attention; or a "restoration-to-normal" signal, indicating the condition that initiated the original off-normal signal has been resolved. A trouble signal indicates a fault in a monitored circuit or component of the fire alarm system, or the disarrangement of the primary or secondary power supply.

(D) Types Of Fire Alarm System

There are mainly two types of fire alarm system:-

(a). Open circuit

(b). Closed circuit

Their condition being reversed each case to raise the alarm.

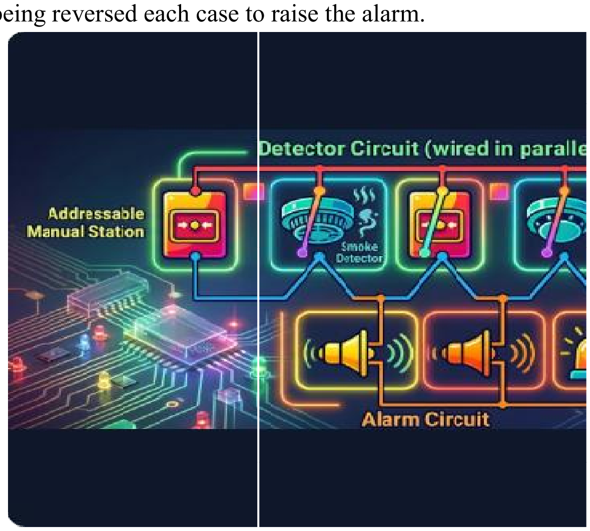

Figure 3.2: Detector circuit

(a). Open Circuit

In 'open' circuit system detector or call point are wired in parallel and can be regarded as switches in the 'off' position i.e. there is no current flow when in standby. The operation of a detector effectively closes the contacts and activates the alarm system. As there is no current flow when on standby it's not self-monitoring as a result, however it doesn't consume as much electricity as 'closed' circuit and is therefore cheaper to run. A short circuits in the detector wring will raise and analarm, as it effectively closes the circuit. A broken circuit, on the other hand, will not and if

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, August 2026
Impact Factor: 8.2

unidentified could render some detector heads in operative. It is important to remember that in all except simplest system the detector and alarm circuit are Separate-meeting only in the alarm control unit.

IV. PROBLEM DOMAIN

If an automatic fire-detection and fire-alarm system is used and maintained properly, its fast response to a fire that is just beginning can greatly reduce the risk to life and limit damage to property. However, features that provide this fast response can also cause false alarms. The aim of this project is to reduce both the nuisance caused by false alarms and the unnecessary costs which may be a direct or indirect result of these alarms. The definition of a false alarm is: 'A fire signal resulting from a cause other than fire'. About 90% of automatic fire-detection and fire-alarm systems do not regularly cause false alarms. However, the remaining 10% are involved in most false alarms. Every false alarm causes disruption.

1 Cause Of False Alarm

False alarms from fire-detection and fire-alarm systems can arise from many different causes, most of which can be dealt with by careful planning. Typical causes of false alarms are:

•Pollutants in the air setting off smoke detectors;
•Extremely high temperatures setting off heat detectors;
•Vandalism or malicious acts;
•Mistakes in using the system;
•The equipment being faulty or not being maintained properly;
•Fire detectors or red 'break glass' boxes being in the wrong place; and
• False alarms can come from three main devices – smoke detectors, heat detectors and 'break glass' boxes.

V. ANALYSIS AND METHODOLOGIES

Automatic fire protection (Fixed) system based on heat detection through thermal fuses/ quartz bulbs/ EP detectors shall be employed. Sensors shall be installed at all critical places described below:

In storage area these detectors shall be provided encircling each vessel, equi-spaced with a maximum spacing of 1 meter at an elevation of about 1.5 to 2.0 meter from bottom of vessel. Also minimum 2 nos. detectors shall be provided at the top of the vessel and at least one near the liquid line ROV to take care of failure of flanges. In case of an automatic thermal fuse based fire protection system the instrument air supply pressure to thermal fuses shall be maintained through a pressure control valve and a restriction orifice. The thermal fuses shall be designed to blow at 79 deg C temperature (max). Instrument air will start leaking as a result of thermal fuse blowing. The capacity of the restriction orifice is such that the discharge of air through even one thermal fuse will depressurize the downstream side of the restriction orifice to below set point of the pressure switch.

LPG Storage Area (Bullet/Horton Sphere Vessel)

Bullet Storage

Calculation Of Number Of Detector To Be Installed:

• Length Of Vessel – 17 Meters
• Total Circumference Of Vessel = 16 + 2 x 3.14 x 0.5 =~ 20 met
• Total No Of Heat Detector = 20 + 3 (Two At Top And One Near Rov Line) = 23
• Total No Of Gas Detector = 1 (Near Rov Line)

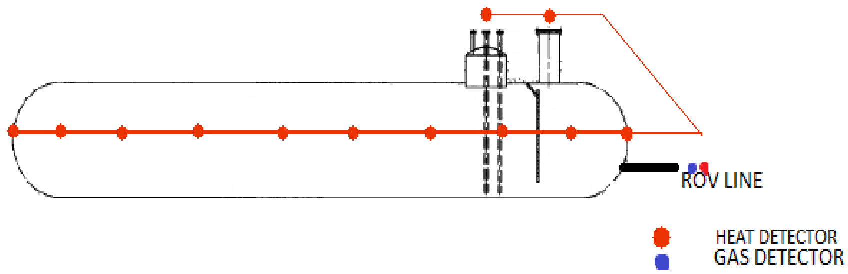

Figure 5.1 Bullet Storage

Horton Sphere Vessel:-

Calculation Of Number Of Detector To Be Installed:

- Horton sphere diameter = 3.2 m
- Total circumference = 2 x 3.14 x r = 2 x 3.14 x 1.6 = 8.96 =~ 9
- Total number of heat detector = 9 + 3 (two at top & one near ROV line) = 12
- Total number of gas detector = 1 (near ROV line)

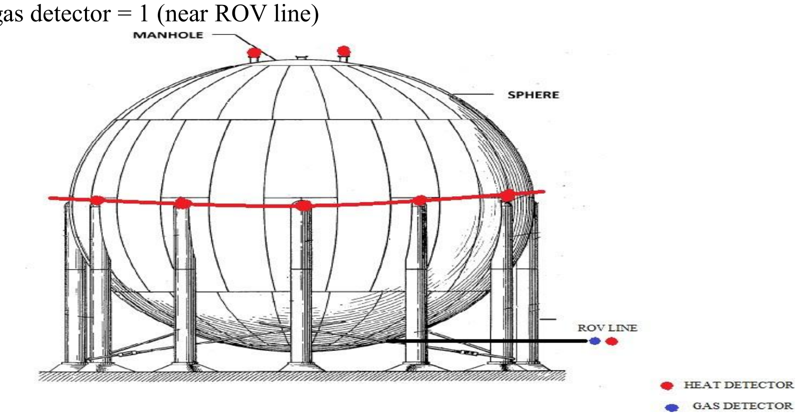

Figure 5.2 Holton sphere vessel

LPG Storage Area (Mounded Storage Vessel)

Automatic fire detection and /or protection (Fixed) system based on heat detection through thermal fuses/ quartz bulbs/ EP detectors shall be provided. Sensors shall be installed at all critical places as below:

- Minimum One detector shall be provided on each exposed portion of the vessel. However, if the nozzles are covered in a dome, each group shall have at least two detectors.
- At least one detector shall be provided near ROV on all liquid line (s).

DOI: 10.48175/IJARSCT-38027

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, August 2026
Impact Factor: 8.2

Figure 5.3 Mounded Storage Vessel

GAS DETECTION SYSTEM

Suitable gas detectors shall be placed at critical locations in the LPG storage area such as near the ROVs, in inspection tunnel, inside the nozzle box enclosure (if provided) or dome connection.

NUMBER OF DETECTOR TO BE INSTALLED:

- Number of heat detector at each nozzle group = 2+2 = 4
- Number of heat detector at liquid inlet = 1
- Number of heat detector at near ROV line = 1
- TOTAL NUMBER OF HEAT DETECTOR = 6
- Number of gas detector inside each nozzle group = 1+1= 2
- Number of gas detector in inspection tunnel = 1
- Number of gas detector near ROV line= 1
- Total Number Of Gas Detector = 4

Manual Call Points:

Manual call points shall be so located that, to give an alarm, no person in the premises has to travel distance of more than 30 m to reach them. Where necessary, the travel distance may require to be reduced to less than 30M e.g. where there is difficulty in free access within the risk or in potentially dangerous risks. Call points shall be fixed at a height of 1.4M above the surrounding Floor level, at easily accessible, well- illuminated and conspicuous positions, which are free of obstructions.

NUMBER OF MANUAL CALL POINT INSTALLED

- Total area = 150 x 300 m. Sq.
- Distance b/w two MCP = 30 m
- Nos. of manual call point at length side = 10 + 7= 17
- Nos. of manual call point at breadth side = 4 + 4 = 8
- Total nos. of manual call point = 17 + 8 = 25
- Determine the optimum location for the detector.
- Mount the detector at the selected location.
- Connect the detector to the sampling pipe network.

Installation should only be done by factory- trained technicians in accordance with Applicable installation requirements. These include:

DOI: 10.48175/IJARSCT-38027

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 1, August 2026 Impact Factor: 8.2

• NFPA 70, National Electrical Code
• NFPA 72, National Fire Alarm and Signaling Code
• OISD 150, Design and safety requirement for LPG mounded storage facilities.
• OISD 144, LPG bottling plant operations.
• Any other local, national, or installation requirements or standards.
• IS-2189

Note: Power should be turned off during installation.

General Requirement

The following equipment are required for the installation of fire detection and alarm system:

Wiring and Cables: It is essential for reliability that the wiring in automatic fire alarm and detection system should be of high standard and suitability protected against the possibility of accidental damage. The thermostatic cables can be used for wiring pen detector circuit. It is mainly used with heat detector.

Power Supplies: Obviously an adequate and reliable power supplies must be available to automatic detection and alarm system. This can be a mains supply or a battery supply. In either case BS rules require that a standby supply must be automatically available in the event of a failure in primary supply. The standby supply will normally be a battery maintain in a fully charge state. This supply can be automatically brought into operation by incorporating a change over relay in the circuit.

Control and Indicating Equipment: The control unit is the nerve centre of any system and is usually placed in a prominent position to ensure that its signal will be easily seen and heard by occupant's fire station etc. It could be designed to perform all or any of the function listed below:

(a). receipt of signals from trigger device e.g. smoke , heat and flame detector together with manual call point

(b).Operate alarm sounder either throughout the occupancy or in any particular sequence related to an evacuation plan for the occupancy.

• transmit the signal to remote manned center for onward transmission to the fire station.
• Indicate from which zone signal is coming not only at the main indicator panel but if necessary at repeater indicator throughout the premises.
• Operate fixed fire-fighting equipment.

Detector and Alarm: In LPG storage area we mainly use heat detector and gas detector. For actuating the alarm manually call point is installed in the periphery of LPG area. Manual call point is directly connected to the control panel of control room.

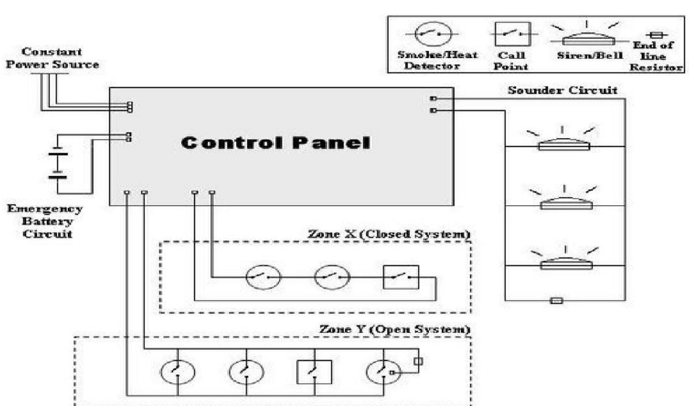

Fig. 1 A schematic diagram of control and indicatingequipment.

IJARSCT

International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

ISSN: 2581-9429

Volume 6, Issue 1, August 2026

Impact Factor: 8.2

VI. APPLICATION DOMAIN

History tells us that when accidents happen, they can be catastrophic. Wherever toxic or inflammable chemicals are being manufactured, processed, stored or shipped, an accident or a substance release is a potential risk. Even small releases of substances can cause harm to people, damage the environment or property. Hence, the use of the canary in providing potential warning for miners and its equivalents in today's technological age. Industrial plants are not designed to leak toxic or flammable gases. However, each piece of equipment used in a process line does have a potential to leak, especially if service routines are not maintained. In each industrial plant there are thousands of devices and pieces of equipment used such as gauges, valves, pumps, compressors and storage vessels. Each joint or connection point is a potential source of release. The goal is to detect an accidental release before it develops into a major hazard.

The need for Fire and Gas Detection -

• Fire & Gas detection is mainly used to monitor areas where hazardous levels of gas or flammable substance are not normally present

• They are designed to give early warning of the build-up of gas or fire before it becomes a hazard to people, infrastructure and environment

• Various national and international laws exist that demand the use of gas or fire detection to protect people and plant

• Many local codes of practice a so exist that ensure health and safety policies are employed

• Insurance companies may not provide cover to businesses that cannot prove that they have taken appropriate safety measures to detect hazardous gases and detection of flame, smoke, heat, or fire.

Application of detectors: When designing a fire protection system, it is important to understand and identify the characteristics and fuel material of a potential fire, the environment in which the detector will be sited and the risk of fire.

VII. CONCLUSION

From the current project we have come to an conclusion that –

• Fire alarm and detection systems are all designed and installed with the same basic objective in mind: detect a fire, effectively alert and provide information to occupants, and signal and provide information to first responders.

• Fire alarm and detection system often represent one of the most important fire protection options for most heritage applications. The successful application of this system is dependent upon careful design and installation of high quality components by capable engineers and contractors. A properly selected, designed and installed system will offer unexcelled reliability.

• The facts which are consider for proper installation of fire alarm and detection system are – Select the right detector for the location / application. Consider varying the sensitivity level of the detector. The installation shall be in accordance with standard and regulations. The installation shall be done in proper supervision of experts.

• The detection by Smoke detector is dependent on number of factor e.g smoke concentration ,size and shape of smoke particle the ionization detector is generally more sensitive to the smaller, normally visible, smoke particle. In the main earlier detection can be obtain with smoke sensitive system than with a heat sensitive one.

• The heat detectors and the fixed temperature type in particular are dependent for their operation on heat being transferred from the surrounding air to the detector itself.

• It's important to be borne in mind when deciding on the suitability and desirable operating temperature of fixed temperature detector. They are generally not suitable to be used in cold condition.

REFERENCES

1. Manual of fireman ship book – 9, Part II, Detection & Alarm Section 9, Raymond grill. IS 2189 – Installation of fire alarm system using heat sensitive type fire detectors.
2. OISD-144

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, August 2026
Impact Factor: 8.2

3. NFPA codes, standards, and recommended practices will provide further information on fire alarm systems as a management tool of fire protection surveillance and fire guard services.NFPA 72, National Fire Alarm Code
4. Bushby, S. T. (2001) "Integrating Fire Alarm Systems with Building Automation and Control Systems," Fire Protection Engineering, No. 11, pp. 5– 7.
5. Carter, R. A. (1999) "Fire Safety and Security in Schools " University of Canterbury, Christchurch, New Zealand, Fire Engineering Research Report 99/1.
6. "Fire Surveillance and Security for Electronic Equipment," Cerberus Alarm, No. 112, Sept. 1991, pp. 1–5.
7. Grosshandler,W. L. (2000), "Multi-Function Sensing for Cybernetic BuildingSystems," Fire Research and Safety, March 1–7, 2000,San Antonio, TX, National Institute of Standards and Technology,Gaithersburg, MD, NISTIR 6588, Vol. 2, pp. 357–364.
8. Jackson, L.(1907), "Guide to Building Fire Protection", Fire ProtectionAssociation, Borehamwood, UK, vol 3.
9. NFPA 601, Standard for Security Services in Fire Loss Prevention.
10. Chen Jing& Fu jingqi (2012)"Fire Alarm System Based on Multi-Sensor Bayes
11. Network" Science direct, safety journal, pp 26-34.
12. Truong Xuan Tung, Jong-Myon Kim (2011) "four- stage smoke-detection algorithm using video images for early fire-alarm systems" , safety journal, pp 161- 172.