

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

MANUALS

FIRE, GAS AND SMOKE DETECTION SYSTEMS

PTS 32.30.20.11

OCTOBER 2009



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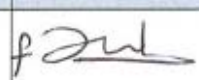
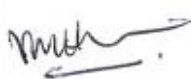
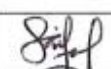
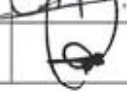
This revision of **PTS 32.30.20.11- Fire, Gas and Smoke Detection Systems** has been updated incorporating:

1. PETRONAS Lessons Learnt
2. Best Practice
3. New information issued by relevant industry code and standards.
4. Incorporate PTS 20.176 - Fire & Gas Detection & Protection System

All updates in the document are highlighted in *italic* font.

The previous version of this PTS September 2002 will be removed from PTS binder/ e-repository from herein onwards.

Document Approval

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Revision History

Date	Version	Description of Updates	Author

Summary of Changes

Section	Changes
1.1 Scope	Adding the following The fire suppressing agent should be non-CFC based e.g. FM 200, CO₂, INERGEN, Water Mist, NOVEC 1230 etc. which when specified should be delivered come with Material Safety Datasheet (MSDS)
2.2.4 Enclosed buildings	Adding the following "Gas monitor settings should generally be at 20% LEL high alarm and 60% LEL high-high alarm. "
Table 1 to 5	Changes were made to these tables to accommodate current requirement for offshore applications e.g. changing the BCF to other clean agent in accordance to current regulatory requirements.
2.2.5 Engines	OCMA requirement were replaced with "EEMUA 107" requirements.
2.2.7 Helidecks	Adding new clause on "Helideck". These requirements were extracted from deleted PTS 20.176.
2.3 Onshore Facilities	Adding the following statement "For manned on-shore process facilities, the need to trip the process facilities on gas and/or fire detection shall be upon recommendation of both the HAZOP studies and IPF studies, with optional QRA studies and fire & gas mapping studies."
Section 3 Item 2	The following statement were added <u>"Ventilation fans</u> For ventilation of more than one compartment, the dampers shall be installed on each individual inlet to each compartment. Note: The fire damper shall not be located in the common header as inadvertent closure of the damper would cause the air blower to run against closed end which may cause integrity/reliability issue with damper itself and the ducting due to pressure difference and pressure build-up. On the fan itself it might experience stall."
Section 3 Item 3	Adding new clause as follows: "3a) CO₂ system The design philosophy shall follow as the minimum NFPA12. 1. Description The system, of the fixed type, is made up of piping normally empty, connected to a set of CO₂ storage cylinders. Nozzles of the open type, distributed and orientated in accordance with the applicable standards installed onto the piping, release the gas within the protected area to contain and extinguish the fire. The intervention of the system is activated automatically by means of the fire detection system which will power up the electric controls located on the pilot cylinder, and/or manually, on site, by means of suitable handle controls acting exclusively on the pilot cylinder of the CO₂ storage set. The intervention of the pilot cylinder will control the opening of all other slave cylinders. The release of gas will activate, by means of a pressure device, the alarm signals, which will then be displayed as the intervention on the control panel CO₂ system alarm panels are installed at strategic location e.g. at door entrance of the gas turbine enclosure to warn the personnel related to the CO₂ system operations. As the minimum, status to display are System "Auto", "Inhibited" and "CO₂ Discharge in progress" The system is activated by a detection system which will actuate, by means of the electrical control the pilot cylinders, the CO₂ discharge (the start discharge is normally delayed of 20-30 seconds). Part of the gas, by means of the pneumatic circuit of the check valve, will pressurise the pneumatic pistons; which in turn, by means of their levers pull the opening control bars of all the remaining cylinders in the cylinder bank.

Section	Changes
	The actuation manual control by means of a push button will follow the above described logic of intervention. To signal the intervention of the system, on the discharge pipe is installed a pressure sensor connected to the system alarm panel. For the emergency, there shall be manual mechanical control by means of a pull handle on the cylinder rack, which upon pulled will initiate the gas discharge. 2. CO2 Cylinder The fire is extinguished thanks to the release within the protected areas of a calculated quantity of carbon dioxide stored on cylinders placed in a safe position, on a suitable rack. The quantity of carbon dioxide is calculated in accordance NFPA 12. The cylinders are made of special carbon steel and tested up to 250 Kg. / cm². Every cylinder is equipped with a special quick release valve and siphon, and complete with a safety disk against over-pressure. The bursting pressure of the safety disk is equal to 250 bar. Each cylinder is further provided with a mechanical weighing device, which indicates that the contents of the cylinders are maximum 10% below their nominal charge. All the cylinders are connected to a manifold by means of flexible hoses. On the connections of the manifold, suitable check valves are installed. These allow the performance of the system even in the case of one or more disconnected cylinders for maintenance purposes. For cylinder unit controlled with pneumatic devices, the pilot cylinder check valves are supplied with a lateral coupling, for the connection of the pressurisation circuit of the pneumatic operator which controls the intervention of the system of levers of all the slave cylinders. 3. The piping network The distribution network is made of piping preferably AISI316L of calculated thickness to cope with the pressure of the gas, connected by means of fittings junctions. Discharge nozzles preferably AISI316L, supplied with purposely calculated drills, are installed onto the piping in the ideal position. The quantity and the location of these nozzles are established according to the type of protection, the discharge time and the characteristics of the area and/or the protected equipment. The nozzles designed are based on the CO2 quantity that must be discharged at the pressure that there is at the nozzle. 4. Sizing The nos of CO2 cylinders shall depend on the volume coverage, size of individual cylinders and the projected concentration. There shall be two sizing based on: - QUICK DISCHARGE of which the project concentration shall be 37% for the 1st one minute. - SLOW DISCHARGE of which the project concentration shall be 30% for 30 min. 5. Test All CO2 systems testing should successfully accomplish the following: • Check the integrity of the piping distribution including cylinders rack, supports and anchors. • Verify detector operation. • Verify audible and/or visual alarm operation. • Verify manual release operation. • Verify that all interlock and shutdown functions operate and occur at the appropriate time in the system discharge sequence.

Section	Changes
	• Actuation sequence conforms to the intended design and pre-discharge time delays (if provided), operates correctly and with the correct time delay period. • All pressure operated devices function as intended at the correct point in the firing sequence. • All safety and warning features are in place and operate satisfactorily. • Design concentration is attained within the appropriate time in accordance with NFPA 12. As per NFPA12 requirements, each carbon dioxide system must be tested with full gas discharge in order to make sure that the project characteristics are observed, causing the intervention of the systems with the distribution of the extinguishing agent in the considered area. Smoke test shall be conducted prior to the actual CO2 discharge test to ensure zero leakage of the enclosure. The OPU Fire Safety Dept. shall be consulted on the requirement for conducting the CO2 discharge test. If conducted, the execution of the test must be entrusted to trained personnel, who are also provided with appropriate tools CO2 analyser recorder, safety equipment etc 3b) FM200 or other system The test philosophy shall be similar to CO2 testing with some variations depending on the MSDS (Material Safety Data Sheet)." Because the high airflow volume of the ventilation system causes a considerable dilution of the gas concentration in the event of a leak, higher gas detector sensitivity shall apply with the following settings: - o 5% LEL for Alarm - o 10% LEL for 2oo3 Trip
Section 4 - Firewater Mains, Pumps and Applications	Added the following clause: "Foam solution application rates, injection times, storage quantities and system design criteria shall be as specified in NFPA 11. 3% foam concentrate shall be used and the foam concentrate injection rate will be 5 or 6 litres/min/m² of tank surface area depending on the product stored." "The helideck foam system shall be capable of providing a blanket coverage of at least 6 litres/min of 3% AFFF foam solution per square metre of helideck prescribed area for a minimum period of 5 minutes."
6.0 Fire Damper Control	No difference in control philosophy is made between fire dampers or a halon damper except that frangible bulls operations is not provided on halon dampers. Replace with No difference in control philosophy is made between fire dampers or a floodingsystem damper except that frangible bulls operations is not provided on floodingsystem dampers.
9.0 Fire, Gas and Smoke Detector Selection	Adding as highlighted in italic The hardwired interface between the detector or control unit and the FGS IPS shall be 4-20 mA, with option for 0-20 mA, where 0-4 mA is used for diagnostics, 4-20mA for the signal and detectors shall be configured individually for alarm purposes, unless zone monitoring is approved or specified by the Principal.

Section	Changes
10.2.1 Selection of Point Gas Detector	Removal of following notes Gas ingress/egress thresholds for gas turbine protection vary widely throughout the Group. Gas ingested is offset by that drawn from the fuel gas supply, and provided detection is prompt and large quantities of fuel rich gas are not ingested, then over-speeding should not result. The danger is turbine runaway, but this requires large quantities of gas which should be detected by the gas detection system installed to protect the area where the leakage occurred. 10 % LEL and 50 % LEL should therefore be the low/high detection thresholds for gas turbines. Adding new note 3: 3. For the outlet ventilation fan, the threshold for outlet ventilation, because the high airflow volume of the ventilation system causes a considerable dilution of the gas concentration in the event of a leak, higher gas detector sensitivity has been introduced as one of the latest standards on new units: ▪ 5% LEL for Alarm ▪ 10% LEL for Trip
10.2.3 Catalytic type detectors	New note added as follows: “4. Infrared type detector will not response to the presence of H₂ gas. In this case, a catalytic type detector shall be used.”
15.7 Requirements for Circuit Integrity	Added new clause: “Note: Line monitoring shall be achieved by serial and parallel resistors at the initiators. The resistors shall be placed as close as practicable to the initiator and should form an integral part of the detector. The resistors shall be of encapsulated type.”
	Changes (strikethrough and italic bold) - field initiators should be individually wired to the control module or to the FGS IPS. Normally closed contacts shall be applied. Line monitoring shall be installed. ~~achieved by serial and parallel resistors at the initiators. The resistors shall be placed as close as practicable to the initiator and should form an integral part of it.~~ - zoning of initiators may be applied in buildings. Zoned circuitry shall be achieved by parallel (normally open contacts) configuration of the initiators. The line monitoring shall be installed ~~achieved by a resistor in series with the initiator which should form part of that initiator, and~~ by terminating the circuit by an encapsulated end of line (EOL) resistor which shall be located furthest away from the control module and which should form an integral part of the last initiator in the chain.
16. Installation Practices for Detectors and Associated Equipment	Adding new clause “However, for detecting gas heavier than air, e.g. H₂S, the sensors may be installed lower than 1m above grade or ground level.”

PREFACE

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They are based on the experience acquired during the involvement with the design, construction, operation and maintenance of processing units and facilities. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPU in oil and gas production facilities, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardisation.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

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1. INTRODUCTION

1.1 SCOPE

This PTS specifies requirements and gives recommendations for the type selection, specification and installation of fire, gas and smoke detection systems (FGSS).

FGSS shall detect at an appropriately early stage:

- the presence of flammable and toxic gases;
- the presence of a fire;
- the presence of smoke from smouldering or incipient fires.

In order to quickly assess the overall situation in the event of an alarm in highly hazardous and low-manned areas with limited direct visibility, the addition of remote plant surveillance by means of Closed Circuit Television (CCTV) may also be considered. For further information on CCTV technology, refer to PTS 32.71.00.10.

- NOTES:
1. Pattern recognition techniques are now being combined with CCTV technology providing an alternative to conventional optical flame detectors. CCTV technology has the potential to overcome many of the shortfalls experienced with optical detectors such as reflections from welding and friendly fires.
 2. CCTV flame detection based on monochrome and full colour technology is available from a number of Manufacturers. Manufacturers' early results with full colour systems seem encouraging as they provide a clear viewable image. This technology may well be ideally suited for unmanned or remote installations where early intervention or operator conformation is required. However, the Principal's approval should be required for the use of CCTV technology as a replacement for conventional optical detection.

For situations that are not covered in this PTS, the codes of the USA National Fire Protection Association (NFPA) should be consulted.

The fire suppressing agent should be non-CFC based e.g. FM 200, CO₂, INERGEN, Water Mist, NOVEC 1230 etc. which should be delivered with Material Safety Datasheet (MSDS).

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY

Unless otherwise authorised by PETRONAS, the distribution of this PTS is confined to companies forming part of PETROANS or managed by a Group company, and to Contractors and Manufacturers nominated by them.

It is intended for use in oil refineries, chemical plants, gas plants and, where applicable, in onshore and offshore exploration and production facilities and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this PTS the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this PTS which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this PTS as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The Contractor is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The Manufacturer/Supplier is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The Principal is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word shall is a requirement.

The word should is a recommendation.

1.3.2 Abbreviations

ALARP	As Low As Reasonably Practical
AFFF	Aqueous Film Forming Foam Concentrate
CAD	Computer Aided Design
CFD	Computational Fluid Dynamics
DCS	Distributed Control System
ESD	Emergency Shut Down
FGS	Fire and Gas System
GPA	General Platform Alarm
HSE	Health, Safety and Environment
IPF	Instrumented Protective Function
IPS	Instrumented Protective System
LED	Light Emitting Diode
LOS	Line of Sight
MFAP	Main Fire Alarm Panel
OEL	Occupational Exposure Limit
PFD	Probability of Failure on Demand
QRA	Qualitative Risk Assessment
SFR	Safe Failure Robustness
SIL	Safety Integrity Level
STEL	Short Term Exposure Limit
TLV	Threshold Limit Value
UPS	Uninterruptible Power Supply

1.4 CROSS-REFERENCES

Where cross-references to other parts of this PTS are made, the referenced section number is shown in brackets. Other documents referenced by this PTS are listed in [\(20\)](#).

2. APPLICATION

2.1 GENERAL

- 2.1.1 It should be noted that the standard caters for only one incident at a time.
- 2.1.2 The level of Protection advocated by this standard should be regarded as the minimum, with each new installation critically examined on its own merits.
- 2.1.3 On offshore complexes, an individual protected area shall be defined as a complete installation separated from any other installation by an adequate distance (e.g. Platform Bridge) or part of an installation segregated from adjacent parts of areas by a firewall(s). Individual decks on the production, drilling, riser and living quarter platform may thus form single risk areas.
- 2.1.4 Area classification shall be as specified in PTS 80.00.10.10.

2.2 OFFSHORE FACILITIES

2.2.1 Unmanned Stations

Minimum requirements for fire and gas detection and protection system for unmanned stations are stipulated in [Table 1](#).

2.2.2 Manned Oil Stations

Minimum requirements for fire and gas detection and protection system for manned oil stations are stipulated in [Table 2](#).

2.2.3 Manned Gas Producing/Processing Station

Minimum requirements for the fire and gas detection and protection system for manned gas producing/process stations are stipulated in [Table 3](#).

2.2.4 Enclosed Buildings

Minimum requirements for fire and gas detection and protection system for enclosed buildings on offshore platforms are stipulated in [Table 4](#).

Ventilation and/or pressurization fresh air intakes of all enclosed buildings shall be provided with three (3) gas detectors.

Totally enclosed areas within hazardous areas shall be made safe by pressurization. Semi/totally enclosed buildings on platform which do not process live hydrocarbons do not require to be fitted with gas detectors.

All semi enclosed safe areas on platforms which process live hydrocarbons shall be fitted with a minimum of three (3) gas detectors.

All totally enclosed safe areas which are deemed to be inadequately ventilated on platforms which process live hydrocarbons shall be fitted with a minimum of three (3) gas detectors.

Gas monitor settings should generally be at 20% LEL high alarm and 60% LEL high-high alarm.

For both manned and unmanned platforms, if two or more gas detectors are activated within the same zone, the platform shall initiate an automatic ESD of that unit.

TABLE 1 - MINIMUM REQUIREMENTS FOR FIRE AND GAS DETECTION AND PROTECTION SYSTEMS FOR UNMANNED PLATFORMS

AREA	DETECTION METHODS	FIXED CONTROL AND EXTINGUISHING SYSTEMS	HAND, PORTABLE AND MOBILE EQUIPMENT	COMMENTS
Wellhead	Fusible Plugs	N/A	Dry powder extinguishers Foam extinguishers	(a) Melting of a fusible plug shall cause platform ESD. (b) Foam extinguishers for drip pan area
Other Process areas e.g. separators, hydrocarbon pumps, launchers/receivers	Fusible Plugs	N/A	Dry powder extinguishers Foam extinguishers	(a) Melting of a single fusible plug, confirmed high level gas or flame shall cause platform ESD. (b) Foam extinguishers for drip pan areas.
Gas Compressor area	Fusible Plugs, Flame and Gas	N/A	Dry powder extinguishers Foam extinguishers	(a) Foam extinguishers for drip pan areas only (b) Melting of a single fusible plug, confirmed high level gas or flame shall cause platform ESD.
Glycol regenerators	Fusible plugs Flame and Gas	N/A	Powder extinguishers	(a) Gas detection for air intake system. (b) Coincident high level gas or flame detection shall cause ESD. (c) Fusible plugs to be at entrance of firebox and vent stack (if applicable). (d) Melting of a single fusible plug shall cause platform ESD.
Internal Combustion Engines				See 2.2.5 – Engines
Enclosed Premises				See Section 2.2.4 – Enclosed buildings
Helidecks	Gas	N/A	Foam Extinguishers Powder extinguishers	(a) Gas detection is only required if gas compressors or other major gas equipment are located below the helideck (b) Coincident high level gas detection shall cause ESD.
Air compressor	Gas	N/A	Powder Extinguishers	(a) Gas detection for air compressor inlet. (b) Coincident high level gas detection shall cause ESD.

NOTE:

- In addition to the fire and gas detection methods, "Kill Knob" (emergency button) shall be provided at appropriate locations, e.g. all escape routes, boat landings, etc. on the platform. The "Kill Knob" will initiate ESD when activated manually.
- H₂S gas detector may be required at the area where the H₂S concentration >10 ppm.

TABLE 2 - MINIMUM REQUIREMENTS FOR FIRE AND GAS DETECTION AND PROTECTION SYSTEMS FOR MANNED OIL PLATFORMS

AREA	DETECTION METHODS	FIXED CONTROL AND EXTINGUISHING SYSTEMS	HAND, PORTABLE AND MOBILE EQUIPMENT	COMMENTS
Wellhead	Fusible Plugs	Water/foam deluge	Hydrants and fire hose. Powder extinguishers. Foam extinguishers.	(a) Melting of single fusible plug shall cause platform ESD and activate deluge systems. (b) Foam extinguishers for drip pan areas.
Other Process areas e.g. separators, hydrocarbon pumps, launchers/receivers	Fusible Plugs Flame and Gas	Water/foam deluge	Hydrants and fire hose. Powder extinguishers. Foam extinguishers.	(a) Melting of single fusible plug shall cause platform ESD and activate deluge systems. (b) Coincident high level gas detectors shall cause ESD. (c) Foam extinguishers for drip pan areas.
Gas Compressor	Fusible Plugs Flame and Gas	Water/foam deluge	Hydrants and fire hose. Powder extinguishers. Foam extinguishers.	(a) Melting of single fusible plug shall cause platform ESD and activate deluge systems. (b) Coincident high level gas detectors shall cause ESD. (c) Foam extinguishers for drip pan areas.
Internal Combustion Engines				(a) See section 2.2.5 .
Enclosed Buildings				(b) See section 2.2.4 .
Air Compressor	Gas	N/A	Powder Extinguisher	(a) Gas detection for air compressor inlet. (b) Coincident high level gas detectors shall cause ESD..
Glycol Regenerators	Fusible plugs Flame and Gas	N/A	Powder extinguishers Hydrant and firehose Foam hose reels.	(a) Gas detection for air intake system. (b) Coincident high level gas detectors shall cause ESD.. (c) Fusible plugs to be at entrance of firebox and vent stack (if applicable). (d) Melting of a single fusible plug or confirmed high level flame shall cause ESD.

Note:

1. In addition to the fire and gas detection methods, "Kill Knob" (emergency button) shall be provided at appropriate locations, e.g. all escape routes, boat landings, etc. on the platform. The "Kill Knob" will initiate ESD when activated manually.
2. If venting is required during ESD, it shall be manually activated from the control room.
3. H₂S gas detector may be required at the area where the H₂S concentration >10 ppm.

TABLE 3 - MINIMUM REQUIREMENTS FOR FIRE AND GAS DETECTION AND PROTECTION SYSTEMS FOR MANNED GAS PRODUCING/PROCESSING PLATFORMS

AREA	DETECTION METHODS	FIXED CONTROL AND EXTINGUISHING SYSTEMS	HAND, PORTABLE AND MOBILE EQUIPMENT	COMMENTS
Wellhead manifolds, Production coolers.	Fusible plugs Flame	Water deluge	Hydrants, fire hose, powder extinguishers.	Melting of a fusible plug or confirmed flame will activate water deluge and cause ESD.
Production/test separators, coalescers, skimmers, contactor tower, glycol storage tank, condensate flash separator, condensate dryer tower.	Fusible plugs Flame and Gas	Water deluge	Hydrants and fire hose, foam hose reels, powder extinguishers.	(a) Melting of a single fusible plug or confirmed flame will activate water deluge and cause ESD. (b) Coincident high level gas detection shall cause ESD.
Glycol regenerators	Fusible plugs Flame Gas	N/A	Hydrants and fire hose, foam hose reels, powder extinguishers.	(a) Gas detection to be at the air intake system. (b) Melting of a single fusible plug or confirmed flame shall activate water deluge and cause ESD. (c) Coincident high level gas detection shall cause ESD. (d) Fusible plugs to be at the entrance of fire box and vent stack.
Launcher/Receiver	Fusible plugs, gas or flame	Water deluge	Hydrant and hose reels, foam hose reels.	(a) Melting of a single fusible plug will activate water deluge and cause ESD. (b) Coincident high level gas detection shall cause ESD.
Vent stacks	IR/ Thermocouples	CO ₂	N/A	(a) IR/Thermocouples detection to alarm only. (b) CO ₂ is to be manually activated.
Fuel Gas/Vent scrubbers	Fusible plugs, Gas/Flame	Water deluge	Hydrants and hose reels, powder extinguishers.	(a) Melting of a single fusible plug will activate water deluge and cause ESD. (b) Coincident high level gas detection shall cause ESD.
Hydrocarbon pumps, lube oil coolers, diesel storage tank, methanol storage tank, brine/LCM/ Condensate tankage area	Fusible plugs, Gas/Flame	Water deluge	Hydrants and hose reels, Foam hose reels.	(c) Melting of a single fusible plug will activate water deluge and cause ESD. (d) Coincident high level gas detection shall cause ESD..
Gas Compressors	Fusible plugs, Gas/Flame	Water deluge	Hydrants and hose reels, powder extinguishers.	(a) Melting of a single fusible plug will activate water deluge and cause ESD. (b) Coincident high level gas detection shall cause ESD..

AREA	DETECTION METHODS	FIXED CONTROL AND EXTINGUISHING SYSTEMS	HAND, PORTABLE AND MOBILE EQUIPMENT	COMMENTS
Air compressors	Gas	N/A	Powder extinguishers	(a) Three (3) gas detectors to cover air compressor air intake and to shutdown air compressor coincident gas detection.
Enclosed buildings				(a) See section 2.2.4 – Enclosed buildings
Internal combustion engines				(a) See section 2.2.5 – Engines
Gas turbines				(a) See section 2.2.6 – Gas Turbines

Note:

1. In addition to the fire and gas detection methods, "Kills Knob" (emergency button) shall be provided at appropriate locations, e.g. all escape routes, boat landings, etc. on the platform. The "Kills Knob" will initiate ESD when activated manually.
2. If venting is required during ESD, it shall be manually activated from the control room.
3. H₂S gas detector may be required at the area where the H₂S concentration >10 ppm.

TABLE 4 - MINIMUM REQUIREMENTS FOR FIRE AND GAS DETECTION AND PROTECTION SYSTEMS FOR OFFSHORE ENCLOSED BUILDINGS

AREA	DETECTION METHODS	FIXED CONTROL AND EXTINGUISHING SYSTEMS	HAND, PORTABLE AND MOBILE EQUIPMENT	COMMENTS
Generator room	Flame Gas	Flooding system subjected to Principal approval	Powder Extinguishers	(a) Confirmed flame detection, gas supply line to the room shall shutdown and blowdown and should initiate the start of the auxiliary diesel generator (if in different location) (b) Three (3) nos of gas detectors for air compressor air intake and to shutdown air compressor upon coincident gas detection.
Electrical or electronic room e.g. control rooms, switch rooms, radio room, inverter/UPS room, SCADA room, termination room, transformer room, etc.	Smoke Gas	Only for remote location require total flooding system. Such system is subjected to Principal approval.	Powder extinguishers	(a) Where applicable, smoke detectors to be in the room plus false floor and false ceiling for flooding system activation. (b) Smoke detection to give GPA only. (c) Confirmed high level gas shall activate ESD.
Battery room	Smoke Gas	N/A	Powder extinguishers	(a) Gas detection is not required if all equipment in the room are certified for use in Zone 2, gas group IIC environment. Confirmed gas detection shall stop of ventilation inhibits boost charge. (b) Smoke detection to give GPA only.
Equipment rooms/workshop	Smoke	Automatic water sprinklers	Powder extinguishers	Smoke detection to activate GPA only.
Gas compressor room	Flame, Gas, Heat	Water deluge	Powder extinguishers	Standard manufacturer detectors for confirmed gas, flame or heat will shutdown the compressor.
LIVING QUARTERS				
Corridors and stairwells	Smoke	Automatic water sprinklers	Hose reels, water extinguishers	Air conditioning shutdown on smoke detection.
Ceiling voids	Smoke	N/A	Hose reels (available from corridor)	(a) Smoke detectors shall only be located in ceiling voids should a significant fire hazard be deemed to exist. (b) Each detector shall have a remote indicator light unit located in the corridor directly in line with the detector.
Cabins	Smoke	Automatic water sprinklers	Hose reels (available from corridor)	Smoke detection to activate GPA only.

AREA	DETECTION METHODS	FIXED CONTROL AND EXTINGUISHING SYSTEMS	HAND, PORTABLE AND MOBILE EQUIPMENT	COMMENTS
Dining/Recreation rooms	Smoke	Automatic water sprinklers	Hose reels, water extinguishers	Smoke detection to activate GPA only.
Galley	N/A	Automatic water sprinklers	Powder extinguishers, Fire blanket Fire blanket	Sprinklers shall not spray onto a deep cooking oil fryer.
Galley hood/duct	Heat	N/A	Powder extinguishers	Heat detection to activate GPA only.
AHU Room	Gas Smoke	N/A	Powder extinguishers	(a) Gas detection to monitor air inlets. Confirmed High level gas shall activate ESD. (b) Smoke detection to trip fans.
Radio Room	Smoke	N/A	Powder extinguishers	(a) Where applicable, smoke detectors to be in false floor and false ceiling. (b) Smoke detection to activate GPA only.
Laundry room/ Locker room/ Store Room	Smoke	Automatic water sprinklers	Powder extinguishers Water extinguishers	(a) Powder or water extinguishers as appropriate. (b) Smoke detection to activate GPA only.

Notes:

1. Remote smoke indicator units shall be installed in the corridors for all detectors except the corridor or ceiling detectors which have integral indicators already visible from the corridor.
2. Multiple smoke detection loops (minimum 2) should be utilised for the ceiling detectors. The grouping of these should be on an alternate detector basis thus maximising coverage in the event that one loop is isolated for maintenance or is faulty.
3. Manual fire alarms stations at each exit from the floor plus at strategic points on the floor, e.g. entrance to stairwell should be installed. These shall not be installed more than 30 m apart.

2.2.5 Engines

Generally, the only form of fire detection/protection for the internal combustion engines can consist of the various types of fire and gas detection system such as fusible plug loop, UV, IR and other fire detection devices.

Precautions shall be taken to ensure that any engine installed in an enclosed area which is required to run in an emergency situation, when normal platform ventilation would be shutdown, is provided with adequate air supply from a non-hazardous area for both combustion and cooling requirements.

Any engine located in a hazardous (classified) zone which is fitted with automatic start-up facilities, shall be protected by gas detectors to both alarm and inhibit the engine start-up sequence if a hazardous environment is monitored. Engines of firewater pumps shall not be located in a hazardous (classified) zone.

All internal combustion engines when operating in a classified zone shall be protected and maintained in accordance with EEMUA 107. Additionally gas engines shall have shielded ignition systems which are 'grounded' by the engine over speed device. (Rig saver is thus not a mandatory requirement for gas engines).

2.2.6 Gas turbines – Refer to [Section 3](#).

2.2.7 Helidecks

2.2.7.1 Manned Installation

The following equipment shall be provided on all helidecks at manned installations:

Fire Fighting Equipment

- (1) Two (2) non-CFC based extinguishers with capacity of 12.0 kg each.
- (2) Four (4) DCP dry powder extinguishers with capacity of 12.0 kg each.
- (3) A low expansion foam application system capable of discharging foam solution onto the landing area at a rate of not less than 6 liters per minute per square meter over an area of 498 sq. m.

Sufficient foam compound to enable the rate prescribed above shall be continuously maintained for a period of not less than 5 minutes.

- (4) 2 fire hydrants shall be installed, one at each side of the deck, adjacent to the access points. Each hydrant shall be fitted with 2 x 0.065m (2½") individually valved instantaneous couplings and a hose box containing 2 x 0.043m (1 ¾") hose and 2 fyrex branch pipes.
- (5) Four low profile foam monitors located one on each side of the helidecks shall be required.

Rescue Equipment

The following rescue equipment shall be provided and contained in a steel box:

- (a) 1 axe - aircraft type
- (b) 1 crowbar, 1 m (3'6") long
- (c) 1 heavy duty hacksaw c/w blade
- (d) 2 spare hack saw blades
- (e) 1 fire blanker (fibre glass type)
- (f) 1 grapping hook with line
- (g) 1 quick release safety knife (Bristol type)
- (h) 1 0.60m (24") bolt croppers

Fireman's Equipment

Every helidecks at manned offshore installation shall be provided with four sets of fireman's equipment.

The sets of equipment shall be kept in pairs, and one pair shall be kept at a place which is readily accessible from the helicopter landing area, while the other is worn by operators during helicopter operations.

Each set of equipment above shall comprise the followings:

- (1) a protective outfit, including gloves, boots, a face mask or hood and helmet;
- (2) a self-contained breathing apparatus;
- (3) a portable battery operated safety lamp capable of functioning efficiently for a period of not less than 3 hours;
- (4) a fireman's axe; and
- (5) a safety harness and lifeline.

2.2.7.2 Unmanned Installation

The following equipment shall be provided on all helidecks at unmanned platforms:

Fire Fighting Equipment

- (1) Two non-CFC based extinguishers with capacity of 12.0 kg each.
- (2) Four DCP dry powder extinguishers with capacity of 12.0 kg each.

Rescue Equipment

For unmanned installation the following rescue equipment are provided and-contained in a fibre glass box:-

- (1) 1 crowbar, 1m (3'-6") long
- (2) 1 axe, aircraft type
- (3) 1 pair of fire proof hand gloves
- (4) 1 quick release safety knife (Bristol type)
- (5) 1 0.60m (24") bolt croppers

Other than stated in Para [2.2.7.1](#) and [2.2.7.2](#), the system requirement for Helidecks should comply with Department of Civil Aviation requirements as specified in CAP437.

2.2.8 Barges

1. Fire Detection and Alarm Systems:-

An automatic fire detection and alarm system shall be provided in all accommodation and service spaces. Service spaces are those used for galleys, main pantries, stores, workshops other than those forming part of machinery spaces, etc.

Detection and alarm are to be the same as those outlined in [2.2.4](#).

2. Fire Protection:-

Sprinklers are to be installed in the accommodation and service spaces, and manual equipment is to be available, similar to those outlined in [2.2.4](#).

Hydrants and fire hoses are to be available on the decks. Machinery spaces also shall be provided with fire hoses.

CO₂ system shall be installed in the engines room.

Gas Detection:-

Gas detection is required in the ventilation inlets to alarm and shutdown the ventilation/air conditioning upon 2 or higher level operation of any two gas detectors.

3. Alarm Panels:-

All fire and gas alarms shall be relayed to the main fire control station which shall be manned or equipped as to ensure that any alarm from the system is immediately received by a responsible member of the crew. Such alarm system shall be constructed to indicate if any fault occurs in the system.

2.2.9 Drilling Rigs

[Table 5](#) gives a summary of the fire/gas detection/protection system required on drilling rigs. For accommodation modules of the rigs, detection and protection systems are to be per [2.2.4](#).

TABLE 5 DRILLING RIGS FIRE/GAS DETECTION/PROTECTION

AREA	DETECTION	FIXED CONTROL AND EXTINGUISHING SYSTEMS	HAND, PORTABLE AND MOBILE EQUIPMENT	COMMENTS
DRILLING RIG				
Drill floor and substructure	N/A	Water monitors	Hydrants & Fire Hose Powder Extinguishers	Gas detection may be incorporated within enclosed substructures where applicable.
Shake Shaker and Active mud tanks	Gas	Water/Foam Deluge	Hose Reel Powder Extinguishers Hydrants & Fire Hose	Deluge system with manual operation from a safe area.
Mud pumps	Gas Smoke	N/A	Hydrant & Fire Hose Powder Extinguishers Hose Reel	
Sack storage	Heat	N/A	Hose Reel Powder Extinguishers	
Bulk storage	Heat	N/A	Hose Reel	
Rig Emergency Room	Smoke	N/A	Powder Extinguishers	
Cement Unit	Gas	N/A	Hydrants	
Mud Laboratory	Gas Smoke	N/A	Powder Extinguishers	Gas Detection to monitor air inlet and on detection shutdown ventilation and electrical equipment and close dampers.

2.3 ONSHORE FACILITIES

The onshore facilities are to be protected by the types of gas and fire detection/protection systems as stipulated by the following documents:-

PTS 80.47.10.30 "Assessment of Fire Safety of Onshore Installation"

This PTS gives the minimum requirements for the design and engineering of fire detection/protection and related facilities for application in onshore oil and gas processing and petrochemical installations, storage facilities, jetties, terminals, loading and unloading facilities. It also stipulates the fire detection/protection requirements for buildings and these requirements shall be additional to those stipulated in the Malaysia Uniform Building By-Laws and BOMBA.

The on-shore facilities manned buildings are additionally covered by :-

Local regulatory by-laws, such as, Malaysia Uniform Building By-Laws

This document spells out the statutory requirements of fire detection/protection of buildings. All buildings shall be built to meet the minimum requirements stipulated by this document.

For manned on-shore process facilities, the need to trip the process facilities on gas and/or fire detection shall be upon recommendation of both the HAZOP studies and IPF studies, with optional QRA studies and fire & gas mapping studies.

3. GAS TURBINES

3.1 General

Turbines provide both sources of fuel and ignition in close proximity and have a high incident rate of fires.

Thus they require a fire and gas detection/protection system. They require large quantities of air both for combustion and for cooling and they are generally installed within acoustic enclosure which allows effective extinguishing of turbine fires and provides containment and segregation of hazards. The fire and gas detection/protection system shall cater for the following hazardous situations:-

- (a) Fire inside the turbine enclosure
- (b) Fire outside the turbine enclosure
- (c) Combustible gas in the turbine combustion/ventilation air intake
- (d) Combustible gas under the acoustic hood

3.2 Fire Detection System

3.2.1 Turbine Enclosure:-

The fire detection system inside the turbine enclosure is to consist of the following:-

- (i) Primary (main) detection using U.V or UV/IR or Triple IR detection or manufacturer's recommendation subjected to approval by Principal;
- (ii) Secondary (back-up, due activation based on prolonged fire occurrence) detection using fixed heat detection.

Sufficient numbers of primary detectors are to be provided to oversee the interior of the gas turbine enclosure. Care shall be taken with location of primary detectors to ensure that they monitor the fuel gas and combustion chamber areas without obstruction by ducts, piping, etc. Heat detectors of appropriate temperature rating shall be incorporated to monitor those areas not seen by primary detectors, e.g. behind inlet and exhaust plenum, lubrication oil systems, heat sources and air flow. Nevertheless, the primary detectors shall ensure maximum detection coverage. The setting and location of the heat detectors shall be determined with the turbine vendor considering temperature profiles in the enclosure. Each compartment may be considered as one zone with at least two out of three (2oo3) voting logic for tripping. One primary detector sensing fire shall alarm and additional one more detectors shall be required to trip the machine. The tripping action generally comprises shut down enclosure ventilation fans and close dampers, isolate and blowdown fuel gas line of the particular turbine, isolate the fuel supply and release CO₂/FM 200 or other equivalent clean agent as per NFPA2001. The actual required tripping action shall be determined by the turbine vendor.

(iii) Ventilation fans

For ventilation of more than one compartment, the dampers shall be installed on each individual inlet to each compartment.

Note: The fire damper shall not be located in the common header as inadvertent closure of the damper would cause the air blower to run against closed end which may cause integrity/reliability issue with damper itself and the ducting due to pressure difference and pressure build-up. On the fan itself it might experience stall.

- (iv) Outside the Turbine Enclosure the fire and gas detection requirements shall follow the appropriate process facilities requirements