



Exploration & Production

GENERAL SPECIFICATION

SAFETY

GS EP SAF 312

Fire and Gas detection systems

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1. Scope

1.1 Purpose

This General Specification sets out the requirements governing the design, selection, installation, location and logic of (automatic) fire and gas detection equipment and systems.

The intent is to detect a potentially flammable, explosive or toxic gas concentration resulting from a leak or to detect a fire as quickly as possible, locate it and initiate:

- Alarms
- Fire-fighting actions
- Automatic safety process actions (shutdown/blow down) to limit escalation of the hazardous event.

1.2 Application

This specification is applicable to onshore and offshore oil and gas production and processing facilities, including technical and residential buildings which are part of the facility.

This specification does not cover the design and functional requirements of the associated automated Fire & Gas safety system(s), which are covered by [GS EP SAF 261](#), [GS EP INS 134](#) and [GS EP INS 198](#).

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
BS EN 61779-4	Electrical apparatus for the detection and measurement of flammable gases - Part 4: performance requirements for group II apparatus indicating a volume fraction up to 100% lower explosive limit
EN 54-20	Fire detection and fire alarm systems – Part 20: Aspirating mode detectors
IECEX	IEC System for Certification to Standards relating to Equipment for use in Explosive Atmospheres (IECEX System) comprising the following:
IEC 60079-0	Explosive atmospheres – Part 0: Equipment – General requirements
IEC 60079-1	Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures “d”
IEC 60079-7	Explosive atmospheres – Part 7: Equipment protection by increased safety “e”
IEC 60079-11	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”
IEC 60079-18	Explosive atmospheres – Part 18: Equipment protection by encapsulation “m”
IEC 60079-10-1	Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres
IEC 60079-10-2	Explosive atmospheres – Part 10-2: Classification of areas – Combustible dust atmospheres
IEC 60079-29-2	Explosive atmospheres – Part 29-2: Gas detectors – Selection, installation, use and maintenance of detectors for flammable gases and oxygen
IEC 60331	Test for electric cables under fire conditions – Circuit integrity-
ISO 7240-1	Fire detection and alarm systems- Part 1 : General and definitions
ISO 7240-5:	Fire detection and alarm systems- Part 5 : Point-type heat detectors
ISO 7240-7	Fire detection and alarm systems- Part 7 : Point-type smoke detectors using scattered light, transmitted light and ionization
ISO 7240-11	Fire detection and alarm systems- Part 11: Manual call points
ISO 7240-12	Fire detection and alarm systems - Part 12: Line type smoke detectors using a transmitted optical beam
ISO 10418	Petroleum and natural gas industries - Offshore production installations - Analysis, design, installation and testing of basic surface process safety systems



Reference	Title
ISO 13702	Petroleum and natural gas industries- Control and mitigation of fires and explosions on offshore production installations – requirements and guidelines
NF S 61-950	Fire detection equipment. Linear heat and multipoint smoke detectors and intermediate elements
RAL – Color Standard	Reichsausschuß für Lieferbedingungen und Gütesicherung

Professional Documents

Reference	Title
API RP 14C	Recommended Practice for Analysis, Design, Installation and Testing of Basic Surface Safety Systems on Offshore Production Platforms
API RP 14G	Recommended Practice for Fire Prevention and Control on Fixed Open-type Offshore Production Platforms
ASTM E 1002	Standard Test Method for leaks Using Ultrasonics
NFPA 13	Installation of sprinkler system
NFPA 72	Automatic fire detectors
NFPA 306	Control of gas hazards on vessels
NFPA 329	Handling releases of flammable and combustible liquids and gases

Regulations

Reference	Title
Directive 94/9/EC – ATEX	European Directive 94/9/EC (23/03/94) of the European Parliament and of the Council on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres

Codes

Reference	Title
Not applicable	

**Other documents**

Reference	Title
HSE-TD-PS-12020-001/5	Storage of Hydrocarbons in Large Atmospheric Storage Tanks- Review of MIIB Recommendations – Final Report, September 2009, revision 3

Total General Specifications

Reference	Title
GS EP ELE 079	Electrical Apparatus for potentially explosive gas atmospheres
GS EP ELE 161	Electrical cables
GS EP HVA 212	Fire Damper(s) Pneumatically Actuated
GS EP INS 101	Instrumentation engineering, supply and construction general requirements
GS EP INS 102	Instrumentation identification
GS EP INS 107	Design and installation of instrumentation links
GS EP INS 134	Design and supply of integrated, control and safety systems
GS EP INS 150	Design method for system configuration – standard functions
GS EP INS 198	Safety and Fire & Gas Standard Functions
GS EP SAF 221	Safety rules for buildings
GS EP SAF 253	Impacted areas, restricted areas and fire zones
GS EP SAF 261	Emergency Shut-Down and Emergency De-Pressurisation (ESD & EDP)
GS EP SAF 331	Carbon dioxide fire extinguishing systems

3. Terms and definitions

There are three types of statements in this General Specification: “shall”, “should” and “may”. They shall be understood as follows:

Shall Is to be understood as mandatory. Any deviation from a “shall” statement requires a derogation approved by the Company.

Should Is to be understood as strongly recommended to comply with the requirements of the specification. Alternatives shall provide a similar level of protection and this shall be documented.

May Is used where alternatives are equally acceptable.

For the purpose of this document only, the following terms and definitions apply.

Failure of equipment	Malfunctioning of equipment, hardware or software related to an external factor (power cut, mechanical damage, cable rupture, etc.) (Company).
Fault of equipment	Malfunctioning of equipment, hardware or software related to an internal factor (device breakdown, error, drifting, virus, etc.) (Company).
FES (Fire and Explosion Strategy)	Results of the process that uses information from the fire and explosion evaluation to determine the measures required to manage these hazardous events and the role of these measures (ISO 13702).
Fire & Gas (F&G) System	A centralised electronic programmable safety instrumented system comprising I/O cards, relays, CPU, logic , voting, human machine interface, etc. in accordance with GS EP SAF 261, and GS EP INS 134. Objectives are: • To provide continuous automatic monitoring functions to alert personnel of the presence of a hazardous fire or gas condition. • To allow executive actions to be initiated manually or automatically in order to minimize the likelihood of escalation. (Company from ISO 13702)
Fire loop	Pneumatic control line containing temperature-sensing elements which, when activated, will initiate control actions in response to a hazardous situation. Examples of temperature-sensing elements are: fusible plugs, synthetic tubing, etc. (ISO 10418).
IMO	International Maritime Organisation
LEL (Lower Explosive Limit)	Concentration of flammable gas, vapour or mist in air below which an explosive gas atmosphere will not be formed (IEC 60079-10-1).
Manual (Alarm) Call point (MAC)	Device for the manual initiation of an alarm (ISO 7240-1)
PFD	Probability of Failure on Demand (Company).
Safe State of equipment	No hazardous condition, i.e. the detection equipment is working correctly, no fire is detected, or gas concentration is below trip threshold value (Company).
Safety Action	Executive actions by the Fire & Gas System as per Cause & Effect matrix (Company).
Trip State	Hazardous condition, i.e. fire is detected, or gas concentration is at/above trip threshold value, causing an automatic executive action (Company).

4. Installation and design requirements

4.1 Environmental conditions

A dedicated specification for each project shall define the indoor and outdoor environmental characteristics of the site, equipment and installations to be monitored. All fire & gas equipment (i.e. detectors, system, final elements) shall be certified for use in the specific environmental conditions.

A special attention shall be paid concerning the temperature in which the equipment shall be installed: the F&G detectors shall be used within their temperature of **ATEX** or **IECEx** certification as per **GS EP ELE 079** requirements.

Materials of construction shall be in accordance with **GS EP INS 101**.

4.2 Electrical supply

In principle, all fire and gas detectors shall be hard-wired and shall be loop-powered from the F&G System at 24 V DC, in accordance with **GS EP INS 101** and **GS EP INS 134**. Other operating voltages shall not be used, and the impact of the detectors total power consumption on the F&G System shall be carefully assessed.

In any case, indoor & outdoor gas detection and outdoor fire detection shall be hardwired.

The F&G System itself shall be powered by a redundant and reliable UPS power source in accordance with **GS EP SAF 261**.

Although 2-wire detectors are preferred, the use of 3 and 4 wire detectors is permitted when required (e.g. for heating, anti-condensing, etc.).

The output signals of any detector (incl. push buttons) shall be either:

- analogue 4-20 mA output signal whenever possible, or else
- discrete (on-off) contact output signal.

In case fail-safe configurations are unsuitable for discrete signals (e.g. push buttons, smoke detectors) then a line-monitoring resistor shall be installed in combination with a line-monitoring device in the F&G System (line failure = safety action).

Pressure switches for fusible loop systems shall not be used; analogue pressure transmitters shall be used.

Any indoor or outdoor electrical or signal cable related to the F&G System shall be fire-resistant as per **IEC 60331** and be in accordance with **GS EP ELE 161**.

4.3 Area classification and electrical certification

All electronic F&G sensors and final elements installed in a hazardous area shall be certified **ATEX** or **IECEx** as per **GS EP ELE 079** requirements for use in:

- Zone 1, Gas Group IIA, Temperature Class T3, by default, or more stringent Gas Groups if required by hazardous area classification
- Zone 1, Gas Group IIC, T3, in case of hydrogen (e.g. battery rooms).

Fire and gas equipment installed in a Zone 0 application (e.g. retention ponds, vent stacks) shall be certified for use in Zone 0, and is limited to intrinsically safe equipment only.

Refer to **GS EP INS 101** for more details on permitted Ex types and **ATEX / IECEx** categories.

In principle, for reasons of standardisation, indoor F&G detection equipment shall be identical brand & model as the Ex-certified F&G detection equipment installed outdoors, with the exception of that smoke and fire detectors installed in living quarters and being part of an addressable fire detection system may be non-Ex-certified.

4.4 SIL Certification

All F&G detection equipment (including push buttons) and final elements (e.g. relays, solenoid valves, etc.) connected to the main F&G system shall be minimum SIL-2 certified by a company approved third party (e.g. TUV, EXIDA, SIRA). SIL requirement for F&G loop shall be assessed during Basic Engineering.

Refer to **GS EP SAF 261** for more details on reliability requirements.

4.5 Detector status indication

All F&G detectors shall have an illuminated means of status indication (alphanumeric or coloured LED(s), or illuminated LCD screen), visible at minimum 3 m distance, to indicate:

- Safe state
- Trip state
- Fault state (when available).

Pressure transmitters for fusible loop systems shall have a standard build-in LCD screen, providing indication of actual pressure or fault state.

4.6 Detector failure output value setting

When this feature is present, the switch (often called burn-out protection) inside the detector which forces the output signal to high or low value in case of detector failure shall be set to:

- High-output signal for analogue F&G detectors
- Low-output signal for analogue pressure transmitters in fusible loop systems
- Open contact for fail-safe discrete output signals
- Close contact for non fail-safe discrete output signals.

4.7 Application limit of addressable type detection systems

Only non-addressable type detectors/systems shall be used for (automatic) executive actions by the main F&G/ESD systems. Therefore fire detected by an addressable type system shall be interfaced with the main F&G/ESD systems, which further controls (automatic) executive actions (via hardwired links exclusively).

Addressable type detectors/systems shall only be used for fire detection in residential buildings (e.g. living quarters or technical building inside residential buildings), in which case the addressable system shall be SIL-2 certified as per **GS EP INS 134**. In case of floating production facilities for which the IMO classification rules stipulate the installation of an addressable fire detection system in any room part of the living quarters or hull, then an additional certification by the applicable IMO classification body shall be provided.

Addressable type systems shall have their own dedicated operator panel, but shall also be connected to the PCS (Process Control System) system for alarm announcement on the CCR (Central Control Room) operator work stations and for event recording (via hardwired or redundant serial communication link). It shall not compromise reliability (see section 4.4) and availability.

5. Selection of detectors

5.1 General

The type of F&G detectors shall be selected upon the characteristic phenomena of combustion and of the predictable initial leak in the monitored zone.

Detection of toxic gases is intended to protect personnel. The main concern is H₂S.

Detectors shall be selected primarily on the basis of the characteristic phenomenon likely to afford the most certain, most rapid detection, i.e.:

For detectors in a closed space with normal ventilation:

- Smoke or gas from combustion
- Flame
- Heat
- Flammable gas
- Toxic gas
- Oil Mist.

For detectors in the open air or in the presence of strong ventilation:

- Flame
- Heat
- Flammable gas
- Toxic gas
- Ultrasonic.

because, in principle, smoke cannot be detected in this case.

Regarding gas detectors, the choice of sensor shall be made on the basis of which gas is to be detected and whether it comprises toxic or flammable/combustible gas. The flammable gas detection function shall be totally separated from the toxic gas detection function.

Table 1: Classification and type of detectors

Classification of detectors	Type of detectors	Standard abbreviations	Standard abbreviations on lay-out and/or P&IDS
Heat detector	Frangible bulb (Sprinkler)	SP	SP
	Fusible plug	FP	RDFP
	Linear fusible tube	FT	
	Thermostatic	TS	RDH [F]
	Rate-of-rise	TV	RDHR [ROR/RC] ⁽¹⁾
	Linear Heat detector (heat sensitive cables)		
	Fusible links ⁽²⁾		RFD
Smoke detectors	Optical (scattered light or transmitted light)	RDOS	RDOS
	Ionization		I
	Early warning smoke detection system - Aspirating Smoke Detector		ASD
Oil Mist detector	Optical oil mist detector		
Flame detector	Ultraviolet	UV	UV
	Infrared	IR	IR
	Single Frequency Infrared	IR	SFIR
	Ultraviolet/ Infrared	UV/IR	UV/IR
	Multifrequency Infrared	MIR	MIR
	Imaging based flame detection ⁽³⁾		
Flammable gas detector	Catalytic (flammable gas including H ₂ detection)	GD	GDC
	Infrared point Gas Detector		GDIR
	Open path detector (Infrared) ⁽⁴⁾		GDB
	IR camera		
	Ultrasonic gas leak ⁽³⁾		UGL
H ₂ S detector (fixed systems)	Semi-conductor	TGD	TGD
H ₂ S detector (portable systems)	Electrochemical		
Low temperature detector (liquefied gas)	Resistance type	LTD	LTD
Manual detection	Manual Alarm Call Point	MAC	