

GENERAL SPECIFICATION

SAFETY

GS EP SAF 222

Safety requirements for turbines, Diesel engines, gas engines and process units in sheltered or enclosed areas

Rev.	Date	Purpose of the revision
06	05/2015	Organisation change – January 2015
05	10/2012	Review to ensure full consistency with mechanical packages specifications
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03	01/2008	Complete review and update
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1. Scope

1.1 Purpose of the specification

This specification defines safety requirements applicable to:

- Gas turbines
- Diesel engines
- Gas engines
- Process units in sheltered or enclosed areas.

Additional information addressing more specifically the Fire & Gas systems and fire suppression systems for packaged rotating machinery installed in a dedicated enclosure is addressed in [GS EP SAF 050](#).

In accordance with the hazard tree for production installations as per [API RP 14J](#), these safety requirements contribute to the fulfilment of the following objectives:

- **Containment of hydrocarbon:** Minimise the number of potential fuel sources and provide automatic safety valves with appropriate ESD logic
- **Prevention of ignition:** Provide adequate spacing from other hazards; provide ventilation; minimise the number of ignition sources; separate fuel sources from ignition sources; provide gas detection devices; provide automatic shut-off devices with ESD logic
- **Mitigation:** Provide fire detection devices; minimise the effects of an explosion, either by position or by protection; minimise the effects of fire, either by position or by passive fire protection; provide means for active fire-fighting
- **Operability:** Although not specifically mentioned in [API RP 14 J](#), Company considers this requirement as of the utmost importance; it bears consequences on layout, accesses, lifting devices for maintenance, condition monitoring capabilities (especially for early warning), controls and all other features that may impact routine operation and maintenance.

This specification provides general requirements applicable to all equipment (Section 4), then specific additional requirements applicable to gas turbines (Section 5), Diesel engines (Section 6), gas engines (Section 7) and enclosed process units (Section 8).

1.2 Applicability

This specification is not retroactive, with the exception of Halon replacement (refer to [GS EP SAF 332](#)). It shall apply to new installations and to major modifications or extensions of existing installations, both onshore and offshore. It does not cover, in particular:

- Electrical rooms where there is **no** fuel source, safe utilities (air, water) and buildings that are normally manned (refer to [GS EP SAF 221](#)).
- Accommodation utilities such as boilers or incinerators (refer to [GS EP SAF 221](#)).

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
API RP 14G	Recommended Practice for Fire prevention and Control on Fixed Open type Offshore production Platforms
API RP 14J	Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities
Arrêté du 21 Novembre 2002	Arrêté du 21 Novembre 2002 relatif à la réaction au feu des produits de construction et d'aménagement
BS EN 13463	Standard for non-electrical equipment for use in potentially explosive atmospheres
IEC 60079-10-1	International Electrotechnical standard - Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres
IP code Part 15	Area classification code for petroleum for installations, part 15 of the Institute of Petroleum Model Code of Safe practice (2005)
NFPA 12	Carbon dioxide extinguishing systems
NFPA 37	Installation and use of stationary combustion engines and gas turbines
NFPA 68	Explosion protection by deflagration venting
NFPA 750	Water mist fire protection systems
SOLAS	Water mist fire protection systems

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Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP ELE 001	Electrical design criteria
GS EP ELE 079	Electrical apparatus for potentially explosive gas atmospheres
GS EP ELE 081	Lighting
GS EP LSO 110	Environmental effects considerations for helidecks
GS EP MEC 010	Rotating Machine Package Specification - Turbogenerator

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Reference	Title
GS EP MEC 011	Rotating Machine Package Specification - Diesel Engine Driven Emergency Generator
GS EP MEC 012	Rotating Machine Package Specification - Diesel Engine Driven Essential Generator
GS EP MEC 013	Rotating Machine Package Specification - Gas Engine Driven Generator
GS EP MEC 020	Rotating Machine Package Specification - Turbopump
GS EP MEC 022	Rotating Machine Package Specification - Fire Fighting Diesel Driven Vertical Pump
GS EP MEC 023	Rotating Machine Package Specification - Fire Fighting Diesel Hydraulic Driven Pump
GS EP MEC 024	Rotating Machine Package Specification - Fire Fighting Diesel AC Generator Driven Submerged Electric Pump
GS EP MEC 030	Rotating Machine Package Specification - Turbocompressor
GS EP MEC 032	Rotating Machine Package Specification - Gas Engine or Electrical Motor driven Reciprocating Compressor
GS EP SAF 050	Fire and Gas System and Fire Suppression System for Packaged Rotating Machinery Enclosures
GS EP SAF 021	Layout
GS EP SAF 216	Area classification
GS EP SAF 221	Safety rules for buildings
GS EP SAF 228	Liquid drainage
GS EP SAF 253	Impacted area, restricted area and fire zones
GS EP SAF 261	Emergency Shutdown and Emergency De-Pressurisation (ESD & EDP)
GS EP SAF 311	Rules for the selection of fire-fighting systems
GS EP SAF 312	Fire and Gas detection systems
GS EP SAF 321	Fire pump stations and fire water mains
GS EP SAF 322	Fixed fire water systems
GS EP SAF 331	Carbon dioxide fixed fire extinguishing systems
GS EP SAF 332	Water mist and gaseous fixed fire extinguishing systems
GS EP SAF 334	Foam fire extinguishing systems
GS EP SAF 337	Passive fire protection: Basis of design
GS EP TEL 140	Public Address and General Alarm (PAGA)

3. Terminology and definitions

There are five types of **statements** in this specification, the “shall”, “should”, “may”, “can” and “must” statements. They are to be understood as follows:

Shall	Is to be understood as mandatory. Deviating from a “shall” statement requires derogation approved by 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 to be understood as permission.
Can	Is to be understood as a physical possibility.
Must	Expresses a regulatory obligation

Note that “will” is not to be understood as a statement. Its use is to be avoided, unless it is necessary to describe a sequence of events.

For the purpose of this specification, the following definitions shall apply:

Active Fire-Fighting (AFF)	Same as Active Fire Protection
Alarm	Audible or visible signal indicating an off-standard or abnormal condition(Company)
Aqueous Film Forming Foam (AFFF)	AFFF are the most commonly used concentrates for foam fire extinguishing systems
Active Fire Protection (AFP)	Any fire protection system or component which requires the manual or automatic detection of fire and which initiates a consequential response (API)
Adequate Ventilation	Ventilation, natural, artificial or a combination of both, sufficient to avoid persistence of flammable atmosphere within sheltered or enclosed area but insufficient to avoid their initial formation or spread throughout the area (IP Code, Part 15)
Control action – or Control	Means of intervention permitted by the design (pressure relief valves, emergency power supply), safety hardware (dump tanks, coolant sprays), or the presence of manually or automatically initiated ESD procedures which are intended to contain a developing situation so that escalation and a major accident may be avoided
Credible event	Incident not unlikely to occur within the concerned area, considering equipment type, nature of process fluid(s), hydrocarbon inventory, process characteristics and the mode of operation (Company)
Dilution Ventilation	Artificial ventilation sufficient to maintain non-hazardous an enclosed area containing a source of release or an aperture into a hazardous area (IP Code, Part 15)

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Emergency Response (ER)	Action taken by personnel on or off the installation to control and/or mitigate a hazardous event (ISO)
Emergency Shutdown (ESD)	Control actions undertaken to shutdown equipment or process in response to a hazardous situation (ISO)
ESD System	System of manual stations and automatic devices which, when activated, initiate installation shutdown (Company)
Enclosed Area	Any building, room or enclosed space within which, in the absence or failure of artificial ventilation, the ventilation is not sufficient to avoid persistence of flammable atmosphere within the area (Company from IP Code, Part 15). In the context of this specification, it can designate an enclosure or a unit room
Engine Enclosure	Enclosed area containing the engine (turbine, gas or Diesel) and part of its auxiliaries, in order to make the area safe and for acoustic purposes
Escape, Evacuation and Rescue (EER)	General term used to describe the range of possible actions including escape, muster, refuge, evacuation, escape to the sea and rescue/recovery (ISO)
Fire and Gas (F&G) system	Safety system which monitors the temperature or the energy flux (fire), the concentration of flammable or toxic gases (gas), and initiates alarm and Shutdown functions at pre-determined levels (Company)
Fire zone	Areas within the installation where equipment are grouped by nature and/or homogeneous level of risk attached to them. The partition into fire zones is such that the consequences of a flammable gas leak, an explosion or a fire corresponding to the worst credible event likely to occur in the concerned fire zone shall not impact other fire zones to an extent where their integrity could be put at risk (Company)
Fuel source	Same as ISO definition of "source of release" (API)
Grade release	<i>Continuous grade release:</i> grade release that is continuous or nearly so (IP Code, Part 15). A release shall be considered as continuous if it is likely to be present for more than 1000 hours per year <i>Primary grade release:</i> grade release that is likely to occur in normal operation. A release shall be considered as primary grade if it is likely to be present between 10 and 1000 hours per year (IP Code, Part 15) <i>Secondary grade release:</i> grade release that is unlikely to occur in normal operation and, in any event, will be of short duration. A release shall be considered as secondary grade if it is likely to be present less than 10 hours per year (IP Code, Part 15)

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Ignition source	Source of temperature and energy sufficient to initiate combustion (API)
Lower Explosive Limit (LEL)	Concentration of flammable gas, vapor or mist in air below which an explosive gas atmosphere will not be formed (IEC 60079-10-1)
Major failure	A conceivable incident that can possibly occur on the facility. Used for the definition of the facility restricted area and impacted area (Company)
Open Area	Open air situation where vapours are readily dispersed (Company from IP Code, Part 15)
PAGA	Abbreviation for Public Address and General Alarm
Passive Fire Protection (PFP)	Coating, cladding arrangements or a free standing system which in the event of fire will provide thermal protection to the substrate to which it is attached or to the protected area and does so independently of a requirement for human, mechanical or other intervention to initiate a response (Company from ISO and API)
Pressurisation	Over-pressurised enclosure: enclosure where artificial ventilation maintains the area at a controlled pressure above the ambient pressure (IP Code, Part 15) Under-pressurised enclosure: enclosure where artificial ventilation maintains the area at a controlled pressure below the ambient pressure (Company)
Restricted Area	Area within the boundaries of the installation and hence under the control of Company, which is affected permanently by normal operation of the facility or exceptionally by the consequences of an emergency situation caused by a major failure (Company)
Rate Of Rise (TV) heat detector	Rate-of-rise heat detector trips when a predetermined or preset temperature rise is reached
Safety concept	Safety engineering document defining the safety requirements for the design of an installation
Sheltered Area	Area within an open area, where ventilation is less than in a true open area, but is still sufficient to avoid persistence of flammable atmosphere within the area (Company) Note: API wording is "partially enclosed area" and IP Code, Part 15 wording is "sheltered or obstructed open area"
Shutdown (SD)	Control actions undertaken to stop operation of equipment or a process. Shutdown can be automatically triggered or initiated by voluntary action
Source of release	Point from which flammable gas, liquid or a combination of both can be released into the atmosphere (ISO)
Thermostatic (TS) heat detector	The thermostatic heat detector is trips when a predetermined or preset temperature threshold is reached

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Trip/ Trip state	Hazardous condition, i.e. fire is detected, or gas concentration is at/above trip threshold value, causing an automatic executive action (as per GS EP SAF 312)
Unit	Division of the installation in a reasonable number of geographic and functional groups of equipment having the same type (hydrocarbon, pressure, inventory, ignition, etc.) and levels (high, medium, low) of risks (Company)
Unit room	Second enclosed area containing the engine (located or not in the engine enclosure), the driven equipment and auxiliaries
Zone 0	Part of a hazardous area in which a flammable atmosphere is continuously present, or present for long periods (IP Code, Part 15)
Zone 1	Part of the hazardous area in which a flammable atmosphere is likely to occur in normal operation (IP Code, Part 15)
Zone 2	Part of the hazardous area in which a flammable atmosphere is not likely to occur in normal operation and, if it occurs, will exist only for a short period (IP Code, Part 15)

4. General requirements

4.1 Layout

4.1.1 Wind

Partially enclosed areas housing equipment handling hydrocarbon shall be located down the prevailing wind from ignition sources and preferably up the prevailing wind from other fuel sources in open areas.

Where a package installed in a sheltered area consists in an ignition source-type driver and a fuel source-type driven equipment, the driver shall be located up the prevailing wind or the package shall be perpendicular to the prevailing wind.

4.1.2 Auxiliary equipment

Auxiliary equipment shall be located with due consideration to the type of hazard they present (fuel or ignition source). It shall be assessed whether auxiliary equipment can be located on the roof of the enclosure.

4.2 Ventilation

4.2.1 Intakes/Exhausts

Air intakes to engines, turbines or ventilation systems to enclosed areas shall be sited in a safe area, **at least 2 metres away from a hazardous area** (refer to **GS EP SAF 216**), and should be up the prevailing wind from the rest of the installation.

It shall be assessed whether ventilation exhausts can be fuel sources (e.g. exhausts from enclosures containing fuel sources and/or which are pre-purged). They shall be properly located and/or elevated considering surrounding ignition sources.

Exhausts from engines or gas turbines shall be positioned considering the three following criteria:

- They shall be regarded as ignition sources and their outlets shall therefore be located 2 metres away from any hazardous area
- Their maximum skin temperature shall be assessed and it shall be determined whether their stack should be located outside hazardous areas and/or fitted with an appropriate thermal insulation (see [GS EP SAF 216](#))
- Elevated exhausts should be free of any interference with lifting (cranes operating sector) and traffic (helicopter approach sector) operation. In this respect a special attention shall be paid to the extent of the exhaust hot gas plume that may constitute a very serious hazard if in the helicopter approach path (see [GS EP LSO 110](#))

For other details refer to specification [GS EP LSO 110](#).

4.2.2 Pressurisation

For pressurisation rules, refer to [GS EP SAF 216](#).

4.2.3 Ventilation

For ventilation rules, refer to [GS EP SAF 216](#).

4.2.4 Cooling, and temperature control

Enclosed areas containing heat sources such as machinery, engines skids, fired process equipment or exothermic reactors (if any) may require cooling ventilation.

A specific study shall be carried out on a case by case basis and/or information provided by the Vendor shall be used to determine the cooling ventilation flow rate requirement.

Cooling ventilation is applicable to all enclosures, regardless of their position inside or outside the restricted area, within or outside a hazardous area.

4.3 Prevention of hazards

4.3.1 Fuel sources

Potential fuel sources and/or combustible inventory in enclosed areas shall be identified and whenever possible grouped together. Their number should be minimised as much as possible and their type shall be selected so as to limit the extent and the type of hazardous area they generate. A special attention shall be paid to the design of fuel gas lines and the type and quality of fittings attached to them.

Degassing vents (generating zones 0) shall be routed outside enclosed or sheltered areas with due consideration to nearby potential ignition sources (e.g. exhaust chimney).

If any, sampling points (generating zones 1) shall be routed outside enclosed areas.

In line with [GS EP ELE 001](#), power transformer shall be of dry type where located inside unit rooms. Oil-type power transformers shall always be installed outside the unit room.

For further details, refer to [GS EP SAF 216](#) in which lists of equipment that are potential sources of release are given.