

GENERAL SPECIFICATION

Safety

GS EP SAF 050

Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures

03	10/2016	Update
02	05/2015	Organisation change – January 2015
01	09/2013	Update
00	10/2012	First issue
Rev.	Date	Purpose of the revision

Owning entity: HSEQ	Managing entity: DSO/TEC/MTH
Approving entity(ies):	

General Specification		GS EP SAF 050
Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures		
Rev.: 03	Effective date: 10/2016	Page: 2 of 31

Contents

1. Scope	3
1.1 Purpose	3
1.2 Application	3
2. Reference documents	4
3. Definitions and abbreviations	5
3.1 Definitions	5
3.2 Abbreviations	5
4. Fire & Gas system and Fire Extinguishing system	6
4.1 Installation requirements	6
4.2 Fire and Gas system design requirements	8
4.3 Detector failure output value setting	11
4.4 Gas detection system.....	12
4.5 Fire detection system	16
4.6 Fire Extinguishing Systems (FES).....	20
4.7 Inspection, maintenance and maintenance inhibits	29
4.8 Tests.....	30

General Specification		GS EP SAF 050
Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures		
Rev.: 03	Effective date: 10/2016	Page: 3 of 31

1. Scope

1.1 Purpose

The purpose of this General Specification is to define the requirements governing the design, selection, installation, operation, maintenance and safety logic of Fire and Gas Systems (FGS) and Fire Extinguishing Systems (FES) dedicated to packaged rotating machinery installed inside a dedicated enclosure, such as, but not limited to:

- Gas turbines
- Gas or diesel engines
- Centrifugal type moto-compressors
- Process screw type compressors.

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

- Alarms (local and remote)
- Automatic fire-fighting actions
- Automatic safety actions (machinery shutdown/blowdown) 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.

This specification is not applicable for machinery which is installed inside a machinery room without dedicated enclosure, in which case the fire and gas detection and extinguishing system shall be part of the overall facility's fire and gas system (ICSS) which shall be in the scope of supply of Contractor.

General Specification		GS EP SAF 050
Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures		
Rev.: 03	Effective date: 10/2016	Page: 4 of 31

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
ATEX Directive 2014/34/EU	Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres (recast)
EN 54-10	Fire detection and fire alarm systems - Part 10: Flame detectors; Point detectors
IEC 60079 (Part 14; 29-1)	Explosive atmospheres - Parts 14; 29-1
IEC 60331	Test for electric cables under fire conditions - Circuit integrity
IEC 61000-5	Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines
IEC 61508-1	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements
IEC 61511-1	Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and software requirements
NFPA 12	Standard on Carbon Dioxide Extinguishing Systems, 2011 Edition
NFPA 72	National Fire Alarm and Signalling Code, 2013 Edition
NFPA 750	Standard on Water Mist Fire Protection System, 2015 Edition

General Specification		GS EP SAF 050
Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures		
Rev.: 03	Effective date: 10/2016	Page: 5 of 31

Total General Specifications

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

Reference	Title
GS EP ELE 079	Electrical apparatus for potentially explosive gas atmospheres
GS EP ELE 161	Electrical cables
GS EP INS 101	Instrumentation Design
GS EP INS 102	Instrumentation Identification
GS EP INS 106	Instrument Installation
GS EP INS 114	Instrument Tubing and Fittings
GS EP INS 115	Instrument Earthing
GS EP INS 116	Instrument Cables

3. Definitions and abbreviations

3.1 Definitions

There are two types of statements in this General Specification: "shall", "may". They are to be understood as follows:

Shall Is to be understood as mandatory. Deviating from a "shall" statement requires derogation approved by Company.

May Is used where alternatives are equally acceptable.

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

Company Total E&P or any Total E&P subsidiary.

Contractor Any Company Total E&P has signed a contract with for the Engineering, Procurement, Construction and Installation of a part of a project.

Vendor The Package Supplier or Vendor.

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).

3.2 Abbreviations

CCR Central Control Room

C&E matrix Cause & Effect matrix

CPU Central Processor Unit

General Specification		GS EP SAF 050
Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures		
Rev.: 03	Effective date: 10/2016	Page: 6 of 31

ESD	Emergency Shut Down
FGS or F&G System	Fire and Gas System
FES	Fire Extinguishing System
GPU	Gas Pump Unit
ICSS	Integrated Control and Safety System
HC	Hydrocarbon
I/O	Inputs / Outputs
LEL	Lower Explosive Limit
MIR	Multifrequency Infrared
PCS	Process Control System
PLC	Programmable Logic Controller
PT	Pressure Transmitter
SIL	Safety Integrity Level
TS	Thermostatic
TV	Rate of Rise
UCP	Unit Control Panel
UPS	Uninterruptible Power Systems
UV / IR	Ultraviolet / Infrared

4. Fire & Gas system and Fire Extinguishing system

4.1 Installation requirements

The fire and gas system (FGS) and the fire extinguishing system (FES) of the package shall comply with the following requirements and the Project applicable documents.

The Manufacturer shall supply all components (piping, cables, etc) and demonstrate during the complete unit string test, the functionality of entire fire and gas detection and protection system associated with the package unit.

4.1.1 Environmental conditions

The fire & gas system and fire extinguishing system instrumentation shall comply with **GS EP INS 101**, **GS EP INS 102**, **GS EP INS 106**, **GS EP INS 114**, **GS EP INS 115** and **GS EP INS 116**.

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 certification as per **GS EP ELE 079** requirements.

General Specification		GS EP SAF 050
Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures		
Rev.: 03	Effective date: 10/2016	Page: 7 of 31

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

4.1.2 Instruments and electrical requirements

Instruments shall be selected and installed in such a way to allow maintenance, testing and calibration without disconnection or removal of any cable or tubing.

All detectors shall be installed in accordance with **IEC 60079-14** regulations.

All equipment under pressure shall be in accordance with the relevant piping class. All instruments and electrical equipment shall be ATEX certified II 2 G (designed for use in Zone 1 hazardous area), Gas Group II A, Temperature Class T3 and shall be selected in accordance with **GS EP ELE 079**.

The degree of protection provided by enclosures shall be IP 66 minimum for outdoor equipment and IP 43 for indoor equipment.

All instruments, including solenoid valves shall be powered by 24 VDC power supplies.

Solenoid valves shall be made of stainless steel material and CENELEC certified EEx "d".

Limit switches shall be of hermetically sealed type and switch contacts shall be gold plated for 24 VDC switching suitable for EEx "d" circuit. The enclosure material for limit switches shall be AISI 316L stainless steel.

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**.

4.1.2.1 Electrical supply

All fire and gas detectors shall be hard-wired and shall be loop-powered from the F&G System at 24 VDC, in accordance with **GS EP INS 101** requirements.

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.

The F&G System itself shall be powered by a redundant and UPS power source.

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:

- Analog signal shall be 0-22 mA covering normal operation (4-20 mA), fault and alarms. If HART is provided then it shall be fixed at factory. Therefore, at site it will only be possible to read the measurement, configuration parameters and diagnostic information. Access to configuration for modifications shall be forbidden.
- Or discrete (on-off) contact output signal.

In case fail-safe configurations are unsuitable for discrete signals (e.g. push buttons) 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 shall not be used; pressure transmitters shall be used.

General Specification		GS EP SAF 050
Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures		
Rev.: 03	Effective date: 10/2016	Page: 8 of 31

4.1.2.2 Earthing

Instrument earthing shall comply with **GS EP INS 115**.

4.1.2.3 Electro Magnetic Interference Protection

All detectors and associated system shall meet emission and Radio Frequency Immunity (RFI) requirements as per **IEC 61000-5**. As a minimum, type-test certificates shall be provided.

4.2 Fire and Gas system design requirements

Packages, as defined in paragraph **Error! Reference source not found.** of this specification, shall be provided with a fire and gas system as part of the package control panel (UCP) in a dedicated PLC able to communicate with the package control PLC, as well as with Plant FGS.

The package FGS shall be based, as a minimum, on a fully dual fault tolerant programmable system (e.g. tolerance to simultaneous faults of one I/O module and one CPU). The FGS system shall be of a non-failsafe design, with outputs utilising “energise to trip” principles. However, outputs for fire dampers will be “de-energise to trip” The system shall use high reliability and high availability equipment.

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.

The fire and gas system shall have line monitoring facilities for testing automatically the integrity of each detector and its associated circuit and shall automatically indicate when faults arise.

The fire and gas system as described in this specification shall be dedicated to the machinery enclosures protection only.

The fire and gas system shall be capable to:

- Elaborate the voting systems
- Generate alarms, trips and actions
- Control the actions with appropriate feed backs such as emergency shutdown, electrical isolation, close fire dampers, FSS activation and discharge, etc.

and shall interface with the UCP control system to initiate the appropriate alarms, trips and associated actions.

It shall also interface with the plant FGS for further safety actions and monitoring.

4.2.1 Application limit of detection systems types

Only non-addressable type detectors/systems shall be used for (automatic) executive actions by the F&G systems.

General Specification		GS EP SAF 050
Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures		
Rev.: 03	Effective date: 10/2016	Page: 9 of 31

The use of addressable F&G System may be proposed by package Supplier, subject to Company review and written approval, with the following conditions:

- System is used for fire and gas detection and protection within the package only.
- The Addressable Fire and Gas Detection System shall consist of the following as a minimum:
 - Field devices (Gas, Fire and Heat Detectors)
 - Addressable Network
 - Addressable System Controller with accessories e.g. interposing relays, isolators, serial interface card etc.
 - Engineering Work Station - Laptop computer with system configuration software.
- As per [EN 54-10](#) regulation, one fault in an addressable loop shall not cause loss of any other detectors' coverage nor impact the good operation of the Addressable Fire and Gas Detection Systems.
- Power distribution to the Flame and Gas detectors within the package shall be designed and implemented in order to ensure no common-mode fault.
- Package Supplier shall ensure that the design life of the Fire and Gas addressable system is compliant with the design life of the package.
- Package Supplier shall ensure that the design and logic of the addressable system (voting, executive actions etc) are compliant with the package requirements.

All gas detectors at ventilation air and combustion inlets shall be connected to plant FGS as these are to detect gas external from the package. The plant ICSS will then transmit a hardwired trip signal to the package UCP. These gas detector models shall be compliant with overall plant FGS; these detectors shall be procured and installed by Package Supplier and cabled to a skid-edge mounted JB for interfacing to plant FGS.

4.2.1.1 Addressable Network

The Addressable Network shall be a fault tolerant digital communication network. The detectors communicate with the System Controller over a digital communication network.

The address of detector is set by hardware switch or addressable system software.

All detectors shall have unique addresses. System shall generate a fault status if the address setting is duplicated. Loop isolators shall be provided to each and every addressable detector to isolate automatically from a loop in case of open or short circuit. The healthy loop section(s) shall remain operable.

Network cables shall be in compliance with [GS EP INS 116](#) for multipairs.

Detectors shall normally be powered by the loop. In the case external power supply required this shall be provided from the System controller package UCP with segregation and redundancy to ensure no common mode failure risk.

General Specification		GS EP SAF 050
Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures		
Rev.: 03	Effective date: 10/2016	Page: 10 of 31

4.2.1.2 Addressable System Controller

The Addressable System Controller shall be located in the package UCP and contain a microprocessor-based fire monitoring system which follows the requirement of NFPA 72. The package UCP shall include all controllers, power supplies, and logic elements to monitor the status of each addressable fire and gas detector. It shall initiate actions based on the status of the initiating devices.

The controller performs all communication, command, and control functions for the system.

The Addressable System Controller shall also provide an inhibit/bypass/testing facility for the testing of each fire detector and manual initiating device without initiating an executive control action. The list of inhibited/bypassed detectors shall be available on the Addressable System Controller display.

The fault statuses, including but not limited to power supply failure, communication fault, detector fault earth shall be available within the System Controller.

The System Controller shall perform the following as a minimum:

- Monitor all fire and gas detectors and alarm on fire and gas detection or fault conditions
- Provide hardwired signals to package PLC in case of fire and gas detection in order to initiate an executive action by package PLC
- Provide the status of all detectors to the package PLC or ICSS Operator Work Station (OWS), by means of serial link
- Self-testing shall annunciate any fault detected in the system
- Voting of addressable fire and gas detectors.

4.2.1.3 Interface

Addressable System Controller shall transmit status information and alarms to the package PLC via a serial link. The data to be transmitted shall include:

- Alarm/Fault/Inhibit/Raw status of each fire and gas detector
- Panel & power supply common fault status.

Addressable Fire Detection shall be time synchronised with Package PLC.

Watchdog shall be provided for monitoring of communication between Package PLC and Addressable System Controller and raise an alarm in case of communication failure.

Signals for executive action shall be hardwired.

Addressable type F&G system shall have its own dedicated operator panel, but 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 4.2.2) and availability.

All other requirements for package Fire and Gas detection shall remain valid.