

GENERAL SPECIFICATION

SAFETY

GS EP SAF 322

Fixed fire water systems

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General Specification		GS EP SAF 322
Fixed fire water systems		
Rev.: 04	Effective date: 05/2015	Page: 2 of 29

Contents

1. Scope	4
1.1 Purpose	4
1.2 Applicability	4
2. Reference documents	5
3. Terms and Definitions	6
4. Deluge systems	7
4.1 Deluged equipment	7
4.2 Application rate	9
4.3 General design	9
4.4 Piping downstream of the deluge valve	10
4.5 Valves	10
4.6 Nozzles	14
4.7 Remote alarm and control	15
5. Water curtains	16
5.1 Exposure protection water curtains	16
5.2 Dilution water curtains	16
5.3 Installation	17
6. Sprinkler systems	17
7. Monitors	17
7.1 Water supply requirement	17
7.2 Characteristics	17
7.3 Location	18
7.4 Installation and control	18
8. Hydrants	19
8.1 Onshore facilities	19
8.2 Offshore facilities	20
8.3 General requirements	20
8.4 Hose Reels	20

General Specification		GS EP SAF 322
Fixed fire water systems		
Rev.: 04	Effective date: 05/2015	Page: 3 of 29

9. Technical documents and tests	21
9.1 Tests	21
9.2 Documents to be supplied	23
Bibliography	25
Appendix 1 Deluge valve typical schematic	26
Appendix 2 Typical nozzle arrangement - Horizontal vessels	27
Appendix 3 Typical nozzle arrangement - Vertical vessels	28
Appendix 4 Typical nozzle arrangement for pumps	29

General Specification		GS EP SAF 322
Fixed fire water systems		
Rev.: 04	Effective date: 05/2015	Page: 4 of 29

1. Scope

1.1 Purpose

The purpose of this general specification is to define the minimum requirements for the design and installation of fire water cooling and extinguishing systems to be installed on onshore and offshore petroleum facilities.

The main fixed systems dealt with in this specification are as follows:

- Deluges
- Water curtains
- Sprinklers systems
- Monitors
- Hydrants
- Hose reels (in French: robinet d'incendie armé).

The choice of adequate fire fighting systems shall be made in accordance with [GS EP SAF 311](#).

1.2 Applicability

This specification applies to all hydrocarbon processing or production facilities, onshore or offshore, excluding onshore aboveground hydrocarbon storage tanks for which protection systems are described in [GS EP SAF 341](#).

Requirements for the protection of LNG installations are defined in other specifications.

The safety rules for the protection of buildings, diesel engines, turbines and process units located in enclosed areas are defined in [GS EP SAF 221](#) and [GS EP SAF 222](#)

Fixed fire water systems

Rev.: 04

Effective date: 05/2015

Page: 5 of 29

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
IEC 60331	Tests for electric cables under fire conditions – Circuit integrity – Fire-Resisting Characteristics of Electrical Cables
IEC 60332-3-10	Tests on electric cables under fire conditions – Part 3-10: Test for vertical flame spread of vertically-mounted bunched wires or cables - Apparatus
ISO 13702	Petroleum and natural gas industries. Control and Mitigation of Fires and Explosion on Offshore Installations – Requirements and guidelines
NFPA 13	Standard for the Installation of Sprinkler Systems
NFPA 15	Standard for Water Spray Fixed Systems for Fire Protection
NFPA 16	Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
NFPA 25	Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems

Total General Specifications

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 PVV 112	Piping material classes
GS EP SAF 221	Safety rules for buildings
GS EP SAF 222	Safety rules for turbines, Diesel engines, gas engines and process units in sheltered or enclosed areas
GS EP SAF 311	Rules for the selection of fire-fighting systems
GS EP SAF 334	Foam fire extinguishing systems
GS EP SAF 341	Location and protection of onshore hydrocarbon storage

General Specification		GS EP SAF 322
Fixed fire water systems		
Rev.: 04	Effective date: 05/2015	Page: 6 of 29

Order of Precedence

In case of conflict or ambiguities between documents, the following order of precedence shall prevail:

- Local laws
- The Safety Concept
- This General Specification
- Professional documents

It shall be noted that international codes and standards should be considered as design guidelines and shall not prevail upon Company documents and HSE policy

3. Terms and Definitions

Shall:

Indicates a mandatory requirement. Any deviation from a “shall” statement requires Company approval through a derogation

Should:

Means that it is strongly recommended to comply with the requirement of the specification. Alternatives shall provide an equivalent level of protection and this shall be documented

May:

Is used where alternatives are equally acceptable

Application rate:

The discharge density of fire water supplied to the area or equipment to be protected, usually expressed in liters/minute/m²

Deluge valve:

A stand alone or skid assembled valve, normally closed, opened by the operation of a detection system or by remote/local manual actuation, supplying fire water to the deluge system

Deluge system:

An arrangement of open type spray nozzles connected by a dry pipe-work, specifically designed to provide exposure protection, control of burning or extinguishment of fire over a dedicated area or equipment.

Foam concentrate:

A concentrated liquid foaming agent that mixes with water and air to form a stable aggregation of small bubbles (foam solution). It can be of low, medium or high expansion type depending on the type of hazard.

Shadow area:

The area not being impinged by fire water due to obstructions or obstacles

Fixed fire water systems

Rev.: 04

Effective date: 05/2015

Page: 7 of 29

Stand-off distance:

The effective distance between the nozzle discharge point and the protected surface

Water wastage:

The quantity of fire water that does not impinge on the area or equipment being protected

4. Deluge systems

The expressions "deluge system" and "water spray system" are equivalent. "Deluge" or "Deluge system" shall be used in the present specification.

Fixed water deluge are installed to provide cooling or fire intensity control. As a general rule, they are not intended to extinguish fires, except when they provide a mean to apply foam to extinguish hydrocarbon pool fires. See **GS EP SAF 334**. A deluge system consists of a number of spray nozzles, always open, fitted onto a length of pipe (generally a ring) kept dry and in which the water flow is controlled by a (or a set of) deluge valve(s).

4.1 Deluged equipment

Unless specific considerations prevail, deluge shall be installed to protect the following equipments:

Table 1: Selection of deluged equipment

Concerned equipment	Remarks	Offshore	Onshore
Wellhead		Yes (1)	No
Process equipment	Vessels, pumps, shell and tube heat exchangers, LACT, column	Yes	Yes (2)
Slug catchers	Finger type only	NA	Yes (3)
Air coolers		Yes (7)	No
Engines	Open air and sheltered area	Yes	Yes (2)
Piping and pig traps	Inside battery limit	Yes	Yes (2)
Compressors		Yes	Yes (4)
Structures		Yes (5)	No
Pipe racks		Yes (9)	Yes (9)
Storage tanks (crude oil + LPG)		NA	Yes (6)
Loading terminal	Road or rail	NA	Yes
Heaters and reboilers	Excluding furnaces	Yes (8)	No
TEG regeneration skid	Triphasic flash drum only	Yes	No
Transformers	Oil filled transformers	Yes (10)	No (10)

Note 1: If wellhead platform is connected to Central Complex where fire water is available.

General Specification		GS EP SAF 322
Fixed fire water systems		
Rev.: 04	Effective date: 05/2015	Page: 8 of 29

Note 2: Deluge shall be installed if HC liquid inventory $> 5 \text{ m}^3$. Deluge shall also be installed, regardless of liquid inventory, if (i) mobile fire-fighting means are not quickly available and/or of sufficient capacity or if (ii) unit layout does not allow for efficient use of fire monitors.

Note 3: Deluge shall be installed on large units (pressure x volume $> 3000 \text{ bar.m}^3$); monitors are adequate for smaller units. Deluge shall be limited to equipment extremities and 5 m beyond.

Note 4: Deluge not necessary if compressor can be located at sufficient distance from other process units and if layout is compatible with fire monitor efficient operation. Particular care shall be given to include lube oil and seal oil systems within the deluge coverage.

Note 5: Restricted only to structures not protected by passive fire protection and whose integrity is a pre-requisite for safe evacuation of personnel.

Note 6: Deluge for tanks larger than 1000 m^3 . For smaller tanks, decision to install deluge shall be governed (i) by availability and capacity of other fixed or mobile fire-fighting systems, (ii) tank geographical location (close vs. remote, time to intervene) and (iii) environmental impact in case of hazard.

Note 7: Deluge only on the three exposed faces of distribution header(s).

Note 8: Fixed deluge system for low expansion foam solution (rate 3 l/min/m^2) on heater shell only, to be avoided onto fire box and flange.

Note 9: Inside unit battery limits and only if surrounding equipment are deluged. Cable trays shall not be deluged. Cables shall be at least flame retardant as per [IEC 60332-3-10](#) and cables related to safety systems shall be fire resistant as per [IEC 60331](#).

Note 10: Large oil filled transformers located onshore should generally be installed within fire resistant masonry walls housing. Therefore, manual fire fighting means adequately located in the vicinity should provide enough means to control any incident related to the transformers. On offshore installations, preference should be given to the installation of dry (sealed) transformers. Where water spray systems are deemed necessary, they should be designed and installed in accordance with [NFPA 15](#), unless other means of fire protection are foreseen (water mist or dry chemical systems).

Fixed fire water systems

Rev.: 04

Effective date: 05/2015

Page: 9 of 29

4.2 Application rate

Once the decision to install deluge has been made as per criteria exposed in **section 4.1** and in accordance with options selected in the SAFETY CONCEPT, water application rate (or discharge density) for burning control or exposure protection shall be calculated according to the following table in accordance with [NFPA 15](#) and [ISO 13702](#) recommendations:

Table 2: Deluge application rate

Equipment	Application rates
Vessels, columns (1), exchangers	10.2 l/min/m ² of the developed surface
Pumps	20.4 l/min/m ² of the floor area, including an outskirt of at least 1.5 m around the foundation/skid
Compressors	20.4 l/min/m ² of the floor area, including an outskirt of at least 1.5 m around the foundation. Protection to include the compressor casing, associated piping and valving, the gearbox, the lube-oil console and other auxiliary equipment
Wellheads (2)	24 m ³ /h minimum per unit 30 m ³ /h minimum per unit for gas wells
Manifold zone	10 l/min/m ² of floor area in the zone
Pipe rack	- Single level: 10.0 l/min/m ² of plane surface - Several levels: 8.2 l/min/m ² (lower level) 6.1 l/min/m ² (intermediate / upper level)
Structural steel members (main spars unprotected by passive fire protection)	- Horizontal: 4.1 l/min/m ² over the wetted area - Vertical: 10.2 l/min/m ² over the wetted area
Transformers (oil filled)	10.2 l/min/m ² of all exposed surfaces

Note 1: Columns shall be deluged up to a height of 12.2 m above grade, or a level at which a pool fire could form. Fire sources shall be investigated to confirm that equipment/structures above 12.2m are not impacted by the effects of fire. Manual fire fighting means shall be provided in the vicinity to enable fire fighters to cover higher parts of the concerned equipment.

Note 2: Deluge for wells shall be made by means of High Velocity (HV) spray nozzles.

4.3 General design

A deluge system consists of a fixed dedicated dry pipe work fed by a deluge valve (or a deluge valve skid assembly) and fitted with open spray nozzles that are arranged to discharge fire water over the area or equipment to be protected.

Fixed deluge systems shall be designed so as to optimize water coverage efficiency and minimize water wastage. The quantity of sprayed water impinging the surface of protected equipment shall not be less than 80%.