

GENERAL SPECIFICATION

SAFETY

GS EP SAF 321

Fire pump stations and fire water mains

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1. Scope

1.1 Purpose of the specification

The purpose of this specification is to define the safety requirements for the design, installation and testing of fire water pumps and fire water mains. It shall be read in conjunction with other Company specifications in particular mechanical, providing more detailed requirements on the subject of fire water pumps.

1.2 Applicability

This specification is applicable for all onshore and offshore facilities where an all encompassing fire water system shall be installed. It is not applicable to the other sites, where Company has decided to install limited fire-fighting water systems. For such cases, specific requirements shall be given by Company.

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
ASME B16.5	Pipe flanges and flanged fittings
API RP 505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone1 and Zone 2
IP 15	Area Classification Code for Installations handling Flammable Fluids: Part 15 of the IP Mode Code of Safe Practice in the Petroleum Industry, 3 rd edition, July 2005
NFPA 12	Standard on Carbon Dioxide Extinguishing Systems
NFPA 20	Standard for the Installation of Stationary Pumps for Fire Protection
NFPA 750	Standard on Water Mist 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 MEC 022	Rotating Machine Package Specification - Fire Fighting Diesel Driven Vertical Pump
GS EP PVV 112	Piping material classes
GS EP PVV 148	Glass - Reinforced plastic Epoxy Resin Piping materials (tubes and accessories)
GS EP PVV 178	Design and erection of Glass Reinforced Plastic (GRP) with Epoxy resins piping system
GS EP SAF 021	Layout
GS EP SAF 253	Impacted area, restricted area and fire zones
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 380	Safety engineering requirements for an F(P)SO

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.

4. Fire water requirement and supply

4.1 Water supply

4.1.1 Onshore facilities

4.1.1.1 Water source

Onshore, the water source may consist of river, lake or pond, sea (for coastal installations), underground water reservoir, public water main.

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The adequacy and dependability of the water source shall be checked to ensure the overall reliability of the fire water system. The water source shall be adequate in quality and quantity all along the year.

The fire water pumps may either be fed directly by the water source or take suction from an artificial water storage replenished by the water source. The water source shall not be used to feed directly the fire water pumps if the source does not meet the same reliability as the fire water pumps (this may be for example the case for underground water reservoir because of risk of well plugging). In such a case, an artificial water storage shall be installed. This storage may be the open type (basin) or closed type (tank).

4.1.1.2 Water storage replenishment system

This system shall be sized adequately to allow the replenishment of the water storage in a time sufficiently short to limit disruption after usage of the fire water for fire-fighting. As a general rule the fire water storage shall be filled up in less than 24 hours, unless otherwise specified by Company.

The replenishment system shall include easy-to-clean suction strainer facilities. Provisions for possible injection of chemicals against algae growth and/or corrosion inhibition in the replenishment and storage system shall be made.

4.1.1.3 Fire water capacity

Where an artificial storage is used, its size **shall not** take into account the make up from the replenishment system. The overall fire water storage shall provide the maximum flow required throughout a minimum period of:

- **6 hours** for fire zones including more than 50 m³ of liquid hydrocarbons (including liquid hydrocarbons storage and inventories) (*)
- **3 hours** for fire zones including less than 50 m³ of liquid hydrocarbons or for non-hydrocarbon facilities (including liquid hydrocarbon storage and all liquid hydrocarbon inventory inside the vessels) (*)

(*) Liquid inventory shall be calculated at NLL (Normal Operating Liquid Level) for each vessel/equipment.

It may be necessary in some instances to provide additional means or increase capacity or sea-water back-up.

4.1.1.4 Fire water pump feeding facilities

Water source or storage shall be located as near as possible to the fire water pumps. If a storage tank is used, it shall be located where risks due to fire, explosion, or impact are at minimum.

Artificial storage shall be provided with a level indicator and the maximum filling level shall be fitted with an overflow. Adequate fencing and basic life saving equipment (buoys, etc.) shall be provided for open type storage (e.g. ponds).

Fire water pump suction shall be direct, siphoning is not acceptable.

4.1.2 Offshore facilities

Fire water pumps shall be generally of submerged vertical type installed in a pump caisson composed of a steel pipe securely attached to the platform for protection against wave action and mechanical damage:

- For fixed offshore platform, pumps shall be either of vertical suspended type with right angle gearbox, if required, or submerged type (electric or hydraulic driven);
- For FPSO, pumps shall be of submerged type (electric or hydraulic driven)

Where practicable, the pump caisson shall be located where it can be protected by the platform framing to minimise the risk of mechanical damage by boats. The pumps shall be located away from lay down areas and, more generally, shall be protected against the fall of heavy loads. The upper extremity of the pump caisson shall be located above the air gap.

The package design shall be of single lift type i.e. all package components shall form a completely and self-contained skid mounted package ready for bolting down on the foundations and hook-up.

4.2 Maximum fire water flow rate requirement

Fire water flow rate shall match the fire water demand in accordance with requirements developed in [GS EP SAF 322](#).

The fire water pumps shall be sized to provide water to the most demanding fire zone (both for cooling, e.g. deluge **and** for fire-fighting, e.g. foam generation), **plus** 120 m³/h for one monitor **plus** an extra capacity of 60 m³/h for fire hoses.

For FPSO a fire management strategy may be put in place: this strategy is to divide the process fire zone into a number of deluge zones. In the event of a fire, deluge shall be initiated in the deluge zone where fire was detected, plus adjacent deluge zones. Process areas remote from the fire would not be deluged. This option shall be justifiable provided it can be demonstrated that a fire cannot extend beyond the deluge zone. In that strategy the largest fire water demand of the deluge zones/areas, plus spare for any future equipment or system alteration, shall determine the dimensioning of the fire water pumps. **Appendix 3** shall be carefully followed to determine the fire water management strategy on the FPSO and the sub-deluge zones assessment.

4.3 Fire main pressure requirements

4.3.1 Fire water pressure maintenance

The fire water main shall be permanently pressurised. In case it is not pressurised by means of a jockey pump, connection to a cooling water supply system or static head from a water storage tank may be envisaged but shall be subject to Company's approval. In any case the fire water network shall be pressurised at 7 barg at the highest point of the fire water network.

The jockey pump shall have a minimum capacity of 30 m³/hr for offshore installations and 60 m³/hr for onshore installations and shall be capable for making up the allowable fire water system leakage. A jockey pump shall always be spared.

Permanent connections between fire water and service water system are allowed only if they do not put the proper operation of the fire water network at risk. However they are not recommended.

4.3.2 Operating pressure

The fire water system components (flanges, fittings, line pipe, etc.) shall withstand the maximum pressure allowed by [ASME B 16.5](#) for flange class 150#.

The fire water pumps and the fire water main shall be designed to supply the adequate flow rates at the most remote location(s). Under flowing conditions, fire water shall be available at 8 barg at the hydraulically most remote monitors, deluge valve or hydrant and at the pressure recommended by the nozzle Manufacturer for the deluge or spray systems. These requirements shall apply even if one supply branch of the fire water mains is blocked (see **chapter 6** (Fire water mains)).

4.4 Fire water treatment

4.4.1 Chemical injection

For all facilities using seawater or brackish water produced from underground reservoirs, a suitable chemical injection system shall be provided to prevent formation and growth of marine organisms. Where possible, preference shall be given to a manual system for batch treatment.

Advice shall be sought from Company specialist for the chemical injection requirements. The determination of the type of chemical, the injection rate and the design of the injection system shall also be approved by Company specialist.

4.4.2 Filtering system

No filtering system shall be installed downstream of the fire water pump station but replenishment water shall be filtered upstream the storage tank. Jockey pumps shall always discharge through a filter.

Filters for fire water service (both replenishment and jockey pump) shall be 100 μ and shall be fitted with a by-pass and all other suitable appliances.

5. Fire water pumps

5.1 Pumping capacity and distribution

The number of pumps shall be adequate to provide at least 100% of the maximum fire water requirement, assuming one fire pump accidentally fails when called to operate. In other words, if n is the number of pumps necessary to produce the required flow rate, a minimum of $n + 1$ pumps shall be installed.

Installation of pumps of individual capacity exceeding 1200 m^3/h shall require agreement by Company. For installation of pumps of such high capacity, it shall be demonstrated and checked that the integrity of the fire water distribution system cannot be impaired by the surge effect during transient flow regimes, that there is no specific drivers limitation and that there is no other drawbacks such as reliability of demand.

For FPSO, individual capacity of fire water pumps shall not exceed 2500 m^3/hr .

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The configuration of the pump station shall be:

- Either 3 x 50%, each pump having a minimum capacity of 50% of the maximum fire water requirement
- Or 2 x 100%, each pump shall have a minimum capacity of 100% of the maximum fire water requirement.

The selection between 3 x 50% and 2 x 100% shall be driven by cost optimisation and material availability. The arrangement 4 x 33% or, say, 4 x 40%, is not recommended, unless it is unavoidable for technical reasons; for instance installation of an additional fire water pump to cover additional needs required by the extension of an existing facility.

For FPSO, the firewater system shall be supplied by 4 sets of fire water pump sets (refer to **GS EP SAF 380**- chapter 7.9.3). In this case each fire water pump shall have a minimum rating of 35% of fire water demand.

Alternate operating procedures, such as use of temporary external fire-fighting means (e.g. offshore: fire-fighting boat) may be adopted by the Company to cover such situations where one pump is under long maintenance period. If not permanently available, provision of space and tie-in facilities for installation of a temporary diesel driven pump shall be provided.

In the case of a 3-pump arrangement it shall be checked if 3 x 67% configuration is achievable at no additional (or marginally higher) cost. If feasible this alternative shall be preferred because, assuming the network operating pressure is 1 bar lower than nominal (i.e. 7 barg instead of 8 barg), only one pump can supply 90% of the total fire water demand.

As a general rule, fire water pumping capacity shall be achieved with dedicated fire pumps. However the use of cooling water pumps for fire water service may be envisaged if they have adequate characteristics (flow and pressure) and if it is demonstrated that they shall ensure a reliable fire water supply in all circumstances, even in case of loss of all utilities. The decision to proceed along these lines shall be subject to a special study and specific approval by Company.

5.2 Pump characteristics

5.2.1 Pump type selection

NFPA 20 shall be used to determine the type of pumps according to their application and the required characteristics. Self priming pumps are not acceptable for fixed fire water pumps.

5.2.2 Pump characteristic curves

As per **NFPA 20**.

All fire pumps shall be suitable for operation in parallel even if normal operation does not require all fire pumps running in parallel.

5.2.3 Pumps accessories

Each pump discharge line shall be fitted with a non return valve, pressure gauge and isolation valve. Refer to **Appendix 1**.