

GENERAL SPECIFICATION

Safety

GS EP SAF 341

Location and protection of onshore hydrocarbon storage

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1. Scope

1.1 Purpose of the specification

The purpose of this General Specification is to define the requirements for the location and the protection of onshore hydrocarbon storage atmospheric tanks and pressure vessels. This General Specification covers the two following:

- Tanks for the storage of liquid hydrocarbons
 - Fixed roof tanks;
 - External floating roofs tanks;
 - Internal floating roof tanks; tanks equipped with geodesic domes for weather protection, retrofitted or from origin, are regarded as internal floating roof tanks.
- Pressure vessels for storage of liquefied hydrocarbons (LPG storage)
 - Above-ground;
 - Underground or under-embankment.

Storage tank safety requirements depend on various parameters (e.g. environmental conditions, location, operability...) which are detailed below. It shall be verified at the various project stages that all these inputs have been adequately addressed and that none of their possible consequences on the safety of the tank farm itself, the installation to which it pertains and public beyond the boundaries of the facility have been overlooked:

- Fluid class (or category) of hydrocarbons stored (NFPA 30 classification is used in this specification);
- Associated transfer operations of fluids with the inlet/outlet isolation valves;
- True vapour pressure at storage temperature;
- Type of storage tanks or vessels (above or underground, fixed or floating roofs);
- Capacity of the storage tanks or vessels (individual, in a bund, overall in the installation);
- Type of bunding or other secondary containment (double walls);
- Impact on inhabited or public places and traffic (roads and railways);
- Vicinity of other storage installations, process facilities, public and fire-fighting facilities.

This General Specification is not a design code and shall not be used as such; its scope is restricted to safety-related issues as follows:

- Layout (refer to **chapter 4**)
- Containment (refer to **chapter 5**)
- Fire prevention and control (refer to **chapter 6**)
- Particular cases (refer to **chapter 7**)
 - Geodesic domes;

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- Double walls tanks;
- Storage of polar products (e.g. methanol);
- Storage of Sulphur-laden products;
- Tanks with handling temperature above 100°C.

1.2 Applicability

This General Specification applies to onshore installations only. It also applies to any installation that has an equivalent storage capacity exceeding 100m³, to new installations and to major modifications or extensions of existing installations as well.

In addition, **twelve design requirements to prevent onshore above ground storage tanks from overfilling** have been included in this specification. These twelve requirements are set in a distinguishable format in **chapter 5**, and are applicable to any tank, **new or existing**:

- Whose working capacity exceeds 100 m³;
- And handling, according to [NFPA 30](#) classification, Class I hydrocarbons (flash point below 37.8°C), or receiving or handling Class II or III hydrocarbons above their flash point.

This General Specification does not cover:

- Tanks having a process function e.g. wash tanks;
- Storage of liquefied hydrocarbons refrigerated or semi-refrigerated;
- Storage of miscellaneous liquid hydrocarbons commonly required for the processing or utilities, such as jet fuel, diesel oil, methanol, glycol, treatment chemicals, etc.
- Under-water storage of hydrocarbons;
- Mobile storage facilities;
- Transfer operations outboard of inlet/outlet isolation valves;
- Provisions for winterisation.

However it is reminded that the hydrocarbons interim storage inside process and utility units, and the transfer operations between tanks and from/to storage units shall be subject to the same Process Hazards Analyses (PHA), including HAZOP techniques, as process equipment and units.

This General Specification assumes that tanks are made of metallic materials. Concrete materials and construction are acceptable for the outer wall of double wall tanks. Any other use of concrete or non-metallic materials and construction for tanks shall be subject to a Particular Project Specification for Company's approval.

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
ANSI/ISA 84.00.01 Part 1	Functional Safety: Safety Instrumented Systems for the Process Industry Sector - Part 2: Guidelines for the Application of ANSI/ISA-84.00.01 Part 1
API PUBL 2510A	Fire-Protection Considerations for the Design and Operation of Liquefied Petroleum Gas (LPG) Storage Facilities
API RP 520 Part II	Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries Part II—Installation
API STD 521	Pressure-relieving and Depressuring Systems
API RP 2003	Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents
API STD 620	Design and Construction of Large, Welded, Low-pressure Storage Tanks
API STD 650	Welded Tanks for Oil Storage
API STD 2000	Venting Atmospheric and Low-pressure Storage Tanks
API STD 2350	Overfill Protection for Storage Tanks in Petroleum Facilities
ASTM D323	Standard Test Method for Vapour Pressure of Petroleum Products
Arrêté du 2 janvier 2008	Arrêté du 2 janvier 2008 relatif aux stockages contenant plus de 50 tonnes de gaz inflammables liquéfiés relevant du régime de l'autorisation au titre de la rubrique n°1412 de la nomenclature des installations classées à l'exception des stockages réfrigérés ou cryogéniques
Arrêté du 3 octobre 2010	Arrêté du 3 octobre 2010 relatif au stockage en réservoirs aériens manufactures de liquides inflammables exploités dans un stockage soumis à autorisation au titre de la rubrique 1432 de la législation des installations classées pour la protection de l'environnement
Code de l'environnement	Code de l'environnement de la République Française
IEC 61511-2	Functional safety – Safety instrumented systems for the process industry sector – Part 2: Guidelines for the application of IEC 61511-1
NFPA 11	Standard for Low-, Medium-, and High-Expansion Foam

Reference	Title
NFPA 30	Flammable and Combustible Liquids Code
NFPA 58	Liquefied Petroleum Gas Code
NFPA 780	Standard for the Installation of Lightning Protection Systems
Rapport GESIP 2011/01	Guide de lecture de la réglementation sur le stockage et le chargement/ déchargement de liquides inflammables. Partie stockage (1432A)

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 142	Valves
GS EP PVV 312	Design and fabrication of metallic vertical storage tanks
GS EP SAF 021	Layout
GS EP SAF 228	Liquid drainage
GS EP SAF 253	Impacted area, restricted area and fire zones
GS EP SAF 262	Pressure protection relief and hydrocarbon disposal systems
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 334	Foam fire extinguishing systems
GS EP SAF 337	Passive fire protection: Basis of design

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.

Atmospheric tank	Storage tank designed to operate at pressures ranging from atmospheric to 2.5 psig (172 mbarg), (API STD 650).
Bund	Area that is surrounded by embankments and/or walls, in order to confine the spillage of hydrocarbons from the storage tanks or vessels. "Bund" has the same meaning as the American wording "dike".
Equivalent storage capacity	The equivalent storage capacity is defined as the sum of all the fixed and mobile capacities, multiplied by the following factors: • Fluids category A: 10 • Fluids categories B, C1 and D1: 1 • Fluids category C2: 1/5 • Fluids category D2: 1/15.
Fire Zone	Area within the installation where equipment is grouped by nature and/or homogeneous level of risks attached to them. The partition of an installation into fire zones results in a significant level of risk. This implies that consequences of a fire, flammable gas leak or an explosion corresponding to the 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).
Fluid category/class	As per Code de l'environnement (Livre V, Titre Ier, Art. R511-9, rubrique 1000), hydrocarbons fluids are categorised as follows: • A Gas is a substance with a absolute vapour pressure is ≥ 101.3 kPa @ 20°C • A liquid is a substance that is not defined as a gas (as per definition above) and that is not solid at 20°C and 101.3 kPa. As per Code de l'environnement (Livre V, Titre Ier, Art. R511-9, rubrique 1412), gases are maintained liquefied so that absolute vapour pressure < 1.5 bara or under pressure whatever the temperature.

Fluid category/class

As per [Arrêté du 3 octobre 2010](#), hydrocarbons liquids are categorised as follows:

- Fluid category A: flammable liquids and any liquid with a flash point < 0°C and with a vapour pressure > 105 Pa at 35°C;
- Fluid category B: flammable liquids with flash point < 55°C and that do not correspond to category A liquids characteristics;
- Fluid category C: liquid hydrocarbons with: 55°C ≤ flash point < 100°C (except heavy oils):
 - C1: Storage temperature above flash point;
 - C2: Storage temperature below flash point.
- Fluid category D: related to heavy oils:
 - D1: Storage temperature above flash point;
 - D2: Storage temperature below flash point.

As per [NFPA 30](#), hydrocarbons fluids are classified as follows:

- Fluid class IA: liquid having a flash point below 22.8°C:
 - IA: Atmospheric boiling point below 37.8°C;
 - IB: Atmospheric boiling point above 37.8°C.
- Fluid class IC: Liquid having a flash point at or above 22.8°C and below 37.8°C;
- Fluid class II: Liquid having a flash point at or above 37.8°C and below 60°C;
- Fluid class IIIA: Liquid having a flash point at or above 60°C and below 93°C;
- Fluid class IIIB: Liquid having a flash point at or above 93°C.

Flash point

Minimum temperature at which a liquid produces vapour in sufficient concentration to form an ignitable mixture with air near the surface of the liquid (e.g. [NFPA 30](#)).

Foam concentrate

A concentrated liquid foaming agent as received from the Manufacturer. For further details, see § 3.3.12 of [NFPA 11](#).

Impacted area

Area that extends beyond the boundaries of the installation but which is nevertheless affected permanently by normal operation of the facility or exceptionally by the consequences of an emergency situation caused by a major failure (Company).

Low-pressure Storage Tank

P up to 15 psig (1.035 barg) ([API STD 620](#)).

Reid Vapour Pressure (RVP)

Vapour pressure of a liquid determined by laboratory testing in a standard manner in the Reid apparatus at a standard temperature of 37.8°C (100°F) ([ASTM-D-323](#)). Not to be confused with the true vapour pressure.

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Restricted area Area within the boundaries of the installation and hence under the control of the Company, affected permanently by normal operation of the facility or exceptionally by the consequences of an emergency situation caused by a major failure. (Company).

Storage, under-embankment Storage vessel that is above grade, but covered by a layer of sand or soil.

Equivalence between height levels:

Terms and definitions in API STD 2350	Equivalent names generally used within E&P or in previous releases of API STD 2350
Critical High (CH) level	Overfill level (in API STD 2350 previous edition),
Automatic Overfill Prevention System (AOPS) level	High High level
High High (HH) level	High level
Maximum Working (MW) level	Maximum Operating Level

Level (as per API STD 2350)	Required Action	Current wording in E&P
Critical High (CH)	Emergency response	Overfill level
Automatic Overfill Prevention System (AOPS)	AOPS alarm and AOPS activation	High High level
High-High (HH)	LAHH alarm and termination response	High level
Maximum working (MW)	Alert	Maximum Operating level
Working capacity		
Minimum working	None	Optional user defined level and alert

Primary containment Tank itself.

Secondary containment Dikes, walls or bunds surrounding a tank or a group of tanks.

Tertiary containment The means by which liquids can be contained/controlled within the site boundary.

4. Layout

4.1 Maximum storage capabilities

4.1.1 Tanks for liquid hydrocarbons

There is no regulatory limitation in size for liquid hydrocarbon storage. In this document, it is assumed that the installation has an equivalent storage capacity which exceeds 100 m³ (see § 1.2), this covering almost any Company's installation. However, less stringent rules (to be defined for each project and in function of local regulation) are acceptable where equivalent storage capacity does not exceed 100 m³. A derogation dossier shall be established and submitted for Company's approval.

Experience has demonstrated that there is a maximum practicable size for the extinguishing of a pool fire, which is about 6 000 m² by fixed systems or by a professional fire brigade. Where capacities are larger, it should be assumed that the fire extinguishing might be impossible. For reasons of fire-fighting effectiveness there should not be more than two rows of tanks in the same bund and between two adjacent access roads.

4.1.2 Pressure vessels for liquefied hydrocarbons

Storage in which the fluid true vapour pressure at storage temperature is above 1.6 bara shall be considered as pressure storage. Maximum capacity of each storage vessel shall be:

- 500 m³, as a general rule, for above-ground vessels. However, larger vessels up to 1200 m³ can be installed, providing a specific risk assessment study is conducted and approved by the Company and it is demonstrated that the risks can be mitigated down to the same level as if the vessel were underground or under-embankment.
- 10000 m³ for underground or under-embankment vessels.

For Liquefied Petroleum Gases (LPG) with a vapour pressure at 15°C above 2 bara (e.g. propane, butane, etc.), the maximum capacity of each above-ground storage vessel is limited at 120 m³ **within process units**.

4.2 Safety distances

As defined in **GS EP SAF 021** and **GS EP SAF 253**, minimum distances shall be governed by three main criteria:

- Definition of the impacted and restricted areas around the installation;
- Minimum distances between units in the installation:
 - between storage and other units;