

## GENERAL SPECIFICATION

### CIVIL WORKS

#### GS EP CIV 202

|                                          |
|------------------------------------------|
| <b>Drainage and underground networks</b> |
|------------------------------------------|

| 05   | 11/2015 | Revision according to GS EP SAF 228             |
|------|---------|-------------------------------------------------|
| 04   | 10/2008 | General review                                  |
| 03   | 10/2007 | Update of references, modification of § 5 and 6 |
| 02   | 10/2005 | Addition of "EP" root to GS identification      |
| 00   | 10/2001 | First issue                                     |
| Rev. | Date    | Purpose of the revision                         |

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## 1. Scope

The present general specification defines the minimum requirements regarding drainage and underground networks design and construction.

The present specification applies to the works and/or supplies for onshore drainage and underground networks. It does not apply to the gas systems, heat distribution, instrumentation and other industrial fluids.

## 2. Reference documents

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

When local national standards, regulations and codes exist, all design, engineering, materials and construction shall conform to their latest requirements, which complete or modify the present specifications.

In case of lack of obligatory local national standards, international norms and standards will be applied.

In case of lack of international norms and standards, national norms and standards listed hereafter will be applied.

In all cases the system adopted shall be coherent, i.e. the various texts shall present no incompatibility. Any dispute shall be resolved by basing works on the most stringent requirement.

The list of specifications and norms quoted is not exhaustive: the Contractor shall respect the secondary standards and regulations, which cover the works described in the present specification.

Certain specifications and norms may be indicated with an issue date. This is for information only and on the understanding that the most recent issue shall be used.

### 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 |
|----------------|-------|
| Not applicable |       |

## 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 CIV 101 | General earthworks                                           |
| GS EP CIV 201 | Design and construction of roads and stabilised area         |
| GS EP CIV 300 | Reinforced and prestressed concrete                          |
| GS EP CIV 405 | Plumbing and sanitary for onshore and offshore installations |
| GS EP ELE 364 | Electrical installations                                     |
| GS EP INS 106 | Instrument Installation                                      |
| GS EP PLR 403 | Installation of onshore pipelines                            |
| GS EP SAF 221 | Safety rules for buildings                                   |
| GS EP SAF 228 | Liquid drainage                                              |
| GS EP SAF 321 | Fire pump stations and fire water mains                      |
| GS EP SAF 322 | Fixed fire water systems                                     |

## 3. Effluents and drainage networks definition

### 3.1 Type of effluents

The different types of effluents are defined at Company's **GS EP SAF 228**:

- Waste waters
- Hydrocarbons
- Chemicals
- Sewage.

Additionally underground water shall be considered for drainage purpose.

### 3.2 Type of drainage networks

The different drainage networks are defined at Company's **GS EP SAF 228**:

- Closed drains
- Open drains
- Other as sampling connections.

Additionally underground water drainage network shall be considered.

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### 3.3 Drainage systems segregation principles

Drainage systems segregation principles are defined at Company's **GS EP SAF 228**:

- Segregation of closed drains and open drains
- Segregation by fire zones
- Segregation of cold and wet effluents
- Segregation of maintenance and operations drains
- Segregation of drains based on piping rating
- Segregation of drip pans
- Segregation of paved areas
- Segregation of open drains based on effluent quality.

Additionally underground water drainage shall be considered.

### 3.4 Effluent quality

According to Company's **GS EP SAF 228**, effluent qualities are defined as:

- Closed Drain (CD), oil-contaminated
- Open Drain type 1 (OD1), permanently oil-contaminated
- Open Drain type 2 (OD2), accidentally oil-contaminated
- Open Drain type 3 (OD3), oil-free
- Other effluents not compatible with OD1, OD2 and OD3 sources.

Additionally underground water is considered of OD3 quality.

## 4. Drainage systems design

The drainage systems shall be designed in compliance with relevant standards and regulations.

### 4.1 Basic data

#### 4.1.1 Topographical

Drainage networks design shall be based on Project topographical positioning and levelling profiles, with consideration to existing topographical levelling profiles, as per relevant Project topographical surveys reports.

Drainage networks design shall be based on Project topographical positioning and levelling profiles, with consideration to existing topographical levelling profiles.

#### 4.1.2 Hydrological

Drainage networks design shall consider both deep and perched underground water table levels.

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Water table levels shall result from relevant Project geotechnical and hydrological surveys report.

#### 4.1.3 Geotechnical

Drainage networks design shall consider soil conditions and geotechnical parameters as per Project geotechnical surveys report.

### 4.2 Design criteria

#### 4.2.1 Drainage networks segregation

According to Company's [GS EP SAF 228](#), drainage networks shall be segregated by type of effluent and by area.

#### 4.2.2 Closed Drain (CD)

Closed drain effluent network shall be designed according to Company's [GS EP SAF 228](#).

LNG and LPG closed drains shall be designed according to Company's [GS EP SAF 228](#).

#### 4.2.3 Open Drain type 1 (OD1)

OD1 effluent network shall be designed according to Company's [GS EP SAF 228](#).

Water draw-off from oil storage tanks shall be regarded as OD1 and corresponding drainage networks shall be designed according to Company's [GS EP SAF 228](#).

#### 4.2.4 Open Drain type 2 (OD2)

OD2 effluent network shall be designed according to Company's [GS EP SAF 228](#).

The particular specifications shall indicate the collection points, the flow and the type of sub-system for each source of polluted water.

The network shall be of "immediate drainage" type that is to say without controlled reduction of the flow, except in the following cases:

- Drainage of water from the containment basins and the drains of tanks (see hereafter)
- Existence, mentioned in the particular specifications, of a balancing reservoir allowing to divert part of the flow before treatment.

Except otherwise stated in the particular specifications, the downstream works limit is the entrance to the Observation Basin or API Separator.

The water shall be collected and transferred by gravity.

It shall be pumped only in case of impossibility of gravity transfer and with the agreement from the Company.

#### 4.2.5 Open Drain type 3 (OD3)

OD3 effluent network shall be designed according to Company's [GS EP SAF 228](#).

All transfers shall be performed by gravity.

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The particular specifications shall indicate the collection points and the flows.

Additionally, the following shall be considered:

#### 4.2.5.1 Rainwater

Except otherwise stated in the particular specifications, rainwater only shall be considered in the maximum flow to be drained.

Rainwater may be discharged in the public environment in conformity with the local regulations and with the Company's approval.

Rainwater from outside areas shall not enter the plant limits and shall be collected and drained to discharge points selected according to the local facilities.

All transfers shall be performed by gravity.

The P.P.S. shall indicate the collection points and the flows.

In case that transfer cannot be designed by gravity, a pumping up system shall be preferred to a pressure system.

The design shall be performed taking into account the rainfall reports provided by the Company.

The basic data shall mention the intensity, the duration and occasionally the frequency of rainfalls.

Except otherwise stated in the P.P.S., the decennial rainfalls shall be taken into account.

The curves: intensity = f (duration) shall be submitted to the Company for approval.

Regarding the superficial drainage (pavement without equipment and skids, for example), a flow of 3 l/m<sup>2</sup>/min shall be taken into account. However, if the design rainfall for the whole area has an intensity higher than 180 mm/h, the actual intensity shall be taken into account.

The total contribution of the flow from a drained area shall be calculated according to the surface of this area, the rainfall intensity during the concentration time and the run-off coefficients corresponding to the soil nature of the catchment basin.

#### 4.2.5.2 Underground water

##### General

Underground water drainage shall be designed according to the following

- Topographical data
- Geotechnical data and parameters
- Hydrology and hydrogeology data
- Existing drainage works as outfalls, sewers and outlets.

The water-catchment, as well as the lowering of the groundwater table, shall be performed by means of filtering trenches.

The protection of the filtering material shall be done by means of a non-woven material.

The superficial side of the trenches shall be tight to the streaming waters.

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The P.P.S. shall indicate the collection points and the flows.

All underground pipe and or network shall in accordance with Company's **GS EP ELE 364** and **GS EP PLR 403** requirements

### Materials

Drainage pipes shall be either of porous concrete or of polyvinyl chloride, as per Company's **GS EP CIV 201**.

Internal diameter, wall thickness and crushing resistance class shall be indicated.

In case of polyvinyl chloride pipes, behaviour to ovalization and buckling shall be indicated.

In case of porous concrete pipes, manufacturing characteristics shall be marked up on the pipes, particularly: manufacturing process, drying mode, date.

The selection of the filtering materials shall be done according to the structure of the soil to be drained and complying with the following formulas (Terzaghi).

Let "n" be the percentage of elements passing through the sieve of size "d<sub>n</sub>":

$$\frac{d_{15}(\text{filtering material})}{d_{85}(\text{drained soil})} \leq 5$$

$$4 \leq \frac{d_{15}(\text{filtering material})}{d_{15}(\text{drained soil})} \leq 20$$

$$\frac{d_{50}(\text{filtering material})}{d_{50}(\text{drained soil})} \leq 25$$

The fines smaller than 2 mm shall be eliminated from any filtering layer. In order to prevent the segregation of the filtering material and to avoid the presence of voids in which the soil fine particles could enter, the uniformity coefficient U of the filtering material shall be lower than 20, that is:

$$U = \frac{d_{60}(\text{filtering material})}{d_{10}(\text{filtering material})} < 20$$

Practically and in almost all cases, mixtures of sand and washed gravel of 2 to 30 mm and 2 to 40 mm may be used.

### Layout flows

The layout of the filtering trenches, as well as the design of the drainage pipes and the non-woven material, shall be the subject to a detailed study, to be submitted to Company approval.

Underground water drainage network may be connected to rainwater system when allowed by local regulation.

## 4.2.6 Other effluents not compatible with OD1, OD2 and OD3 sources

### 4.2.6.1 Domestic sewage

A dedicated collecting network and specific treatment units (e.g. degreaser) are required to handle wastes from living quarters, kitchen and sanitary facilities. Domestic waste waters shall not be mixed with other drainage effluents and shall be treated prior to disposal.

This water comes from kitchens and sanitary facilities (sinks, kitchen appliances, showers, bathtubs, urinals, W.C., etc.) and from ground siphons of these premises.

It may be sent to the public sewerage system, if exists, with the Company and the Local Authorities authorisations.

Otherwise, it shall be sent into purifying equipment (mini purifying station, septic tank, etc.) before discharge in the system of water non-polluted by hydrocarbons.

In case of an isolated building, the discharge shall be done by underground spreading, filtering well, etc., and this with the Company and Local Authorities authorisations.

In any case, the local sanitary regulations shall apply.

For remote buildings, the flow to be considered is the one used for building plumbing design, according to Company's **GS EP CIV 405**.

For accommodation residential bases with family occupancy, the flow to be considered is the peak flow given by the formula:

$$Q_p = \frac{2.4 \times q \times E_q \times N}{86400}$$

In which:

- $Q_p$  Peak flow, in l/s
- $q$  Average daily flow to be discharged, in l/day.inhabitant (taken as 150 if no particular specification indicates a value)
- $E_q$  Equivalent number of inhabitants per dwelling (considering separately residents and employees)
- $N$  Number of dwellings served by the piping
- 2.4 Peak coefficient

For accommodation residential bases with single rotational persons, the flow to be considered is the same one than above, except differently prescribed at the P.T.S.

For flow consideration, a sewer is a closed pipe conveying solid materials within the liquid; the filling factor shall be equal to 0.7.

### 4.2.6.2 Chemicals

Chemicals effluent network, including but not limited to:

- Chemical injection skids
- Laboratory effluents