

GENERAL SPECIFICATION

Safety

GS EP SAF 228

Liquid drainage

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1. Scope

1.1 Purpose

This General Specification defines the safety requirements for **liquid drainage** facilities in oil and gas production and storage installations in order to minimise spillage and risk of hydrocarbon ignition and subsequent fire escalation. This document also aims to minimise direct discharge of polluting streams to the environment by channelling them to appropriated treatment units, in line with **GS EP ENV 001** requirements.

This General Specification is concerned with the design of **open drains** and **closed drains** for the safe collection of hydrocarbons and contaminated liquids (including waste water) from process, storage and utility areas not only during normal operation (evacuation of rainwater) and maintenance, but also in case of emergency (loss of containment and accidental spillage, evacuation of fire water).

1.2 Applicability

This General Specification is applicable to all new installations designed by or on behalf of Company. Modifications and extensions of existing installations should also comply with this specification, unless it is demonstrated and documented that it results in inconsistencies that are detrimental to the overall safety level of the installation.

This General Specification:

- Applies to all onshore and offshore installations, fixed and floating, handling liquid hydrocarbons, including liquefied gases.

This General Specification does not cover:

- Hydrocarbon gases and vapours disposal facilities (covered by **GS EP SAF 262**)
- Treatment of produced water (i.e. water from reservoir) and utility waters (e.g. cooling water, desalinated water, potable water, boiler feed water, etc.)
- Containment of accidental spillage from onshore storage facilities (covered by **GS EP SAF 341**)
- Detailed design of **oily water treatment** facilities to achieve the specification set for disposal of waste water to the environment
- Design of the facilities treating the drainage effluents not compatible with oily water, such as chemicals, drilling cuttings, solids, domestic sewage
- Collection of LPG / LNG spillage offshore (on deck or on boat)
- Detailed design of the instrument drains (covered by **GS EP INS 900**), except for the basic principles of segregation mentioned in this document
- The mobile marine facilities covered by IMO code (International Maritime Organisation) other than **F(P)SO's**
- Marine systems on **F(P)SO's** like bilge waters, ballast waters, etc. (covered by **GS EP STR 651**)

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The drawings and figures cited in this specification are typical and should not be regarded as detailed engineering documents. They illustrate some recommendations made in the specification and should be used as a basis for the preparation of Project documentation.

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
API RP 14C	Recommended Practice for Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms
API RP 14J	Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities
API RP 55	Recommended Practice for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide
EN 1473	Installation and equipment for liquefied natural gas - Design of onshore installations
EN 14620-1	Design and manufacture of site built, vertical, cylindrical, flat-bottomed steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0°C and -165°C - Part 1: General
IEC 61882	Hazard and operability studies (HAZOP studies), Application guide
EI 15	Model code of safe practice Part 15 - Area classification for installations handling flammable fluids (Previously IP Code, Part 15 or IP 15)
IMO MARPOL	International Convention for the Prevention of Pollution from Ships
IOGP Report No. 6.52/244	Glossary of HSE terms
ISO 13702	Petroleum and natural gas industries - Control and mitigation of fires and explosions on offshore production installations - Requirements and guidelines

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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 CIV 202	Drainage and underground networks
GS EP CIV 403	Temporary construction camps and associated facilities (onshore)
GS EP COR 005	Material selection for oil and gas production systems
GS EP ECP 101	Glycol (TEG) package unit
GS EP ECP 103	Process sizing criteria
GS EP ENV 001	Environmental requirements for projects design and E&P activities
GS EP ENV 270	Deep well disposal
GS EP INS 900	Instrument Hook-up Diagram
GS EP PVV 112	Piping material classes
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 216	Area classification
GS EP SAF 221	Safety rules for buildings
GS EP SAF 253	Impacted area, restricted area and fire zones
GS EP SAF 261	Emergency Shutdown and Emergency Depressurisation (ESD & EDP)
GS EP SAF 262	Pressure protection relief and hydrocarbon disposal systems
GS EP SAF 321	Fire pump stations and fire water mains
GS EP SAF 341	Location and protection of onshore hydrocarbon storage
GS EP SAF 380	Safety engineering requirements for an F(P)SO
GS EP STR 651	General principles for a F(P)SO Design

3. Terminology and definitions

There are five types of **statements** in this specification, the “shall”, “should”, “may”, “can” and “must” statements. They are to be understood as follows:

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

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Should Is to be understood as strongly recommended to comply with the requirements of the specification. Alternatives shall provide the same level of protection or performance and this shall be documented.

May Is to be understood as permission.

Can Is to be understood as a physical possibility.

Must Expresses a regulatory obligation

Note that "will" is not to be understood as a statement.

For the purpose of this specification, the following **definitions** apply:

API separator Gravity-differential type oil-water separator and auxiliaries designed according to API recommendations (American Petroleum Institute). This is an open pit used onshore in the **primary treatment** of waste water.

Bunded areas Bunded areas are areas surrounded by embankments and/or bund walls at or above grade level that are designed for the containment of major accidental spillage and are connected to the open drains via a normally closed valve. "Bund" has the same meaning as the American wording "dike". Not to be confused with **drip pans** and **impounding basins**.

Catch basin Catch basins are onshore recessed, grated drainage collection points within a drainage curbed area to channel the surface liquids to the open drain system.

Closed drain Closed drains are fully contained drains, hard piped from the equipment to be drained to the treatment facilities.

Disposal tube Facility installed in offshore oil and gas installations as the last **oil trap** before disposal of **oily water** to sea.

Drip pans Drip pans (or trays) are designed to collect, contain and route the oily drips to the installation drain systems (hydrocarbons, oils, greases likely to occur underneath process equipment and machines during normal operation). They are permanently connected and lined up to the installation open drain systems. Not to be confused with **bunded areas** and **impounding basins**.

Excess water Onshore: Rainwater or firewater from a paved area after the **time of concentration** has elapsed. This water being oil free, it can be discharged to OD3.

Offshore: Rainwater or firewater discharged to sea from the high capacity gullies (see Figure 5-A).

Fire break / gas seal U-shaped siphon whose low point is normally filled with liquid, aimed at preventing fire and gas propagation between two different segments of an open drains piping system.

F(P)SO Floating (Production) Storage Offloading facility

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Gas blow-by	Gas blow-by via a liquid outlet piping can occur in the event of a loss of liquid level in a gas/liquid separator connected to a lower pressure system. This can result in a risk of over pressuring the low pressure system.
GRP	Glass fibre Reinforced Plastics used in the fabrication of non-metallic piping.
Hazardous area	A three-dimensional area in which a flammable atmosphere may be expected to be present at such frequencies as to require special precautions for the control of potential ignition sources. (Company from EI 15)
High volatility hydrocarbon liquids	They are Category A petroleum fluids as per EI 15 and GS EP SAF 216 . Any flammable liquid that, on release, would vaporise rapidly or substantially. Includes LPG and lighter flammable liquids e.g. LNG. Also includes any flammable liquid at a temperature sufficient to produce, on release, more than 40% vol vaporisation with no heat input other than from the surroundings.
Impounding basin	Impounding basins are basins below grade level that are designed for the containment of major accidental spillage. They can be equipped with an uplift pump for rainwater removal, but this pump is not intended to transfer hydrocarbon liquids. The impounding basin is located adjacent to the process equipment it serves, not underneath. Not to be confused with drip pans and bunded areas .
Maintenance drain	Closed system which collects liquid drains from depressurised equipment and piping. The system is used for maintenance purpose only. The connection to equipment is normally isolated (or locked). See detail in section 7.1.
Minimum installation	Installations handling oil and gas for production or transfer purposes, with no processing facilities. <u>Offshore</u> , they are the satellite wellhead and/or manifold platforms which are not bridged to a process installation. <u>Onshore</u> , they are the remote (stand-alone) wellhead and/or production manifold clusters. A minimum installation may include helideck, (dry) firewater network, electrical cabin, vent with associated Knock-Out (KO) drum, etc. Test separators and pig traps are not considered as processing facilities. Wellhead platforms or clusters with Free Water Knock-Out drums or water degassing drums or gas-lift compressors are not considered as minimum installations.
Observation basin	Facility installed in onshore oil and gas installations as the last oil trap before disposal of oily water to public environment. It is an open pit designed to retain the drainage effluent for a certain time.
Oil trap	Facility designed to retain and allow recovery of floating liquid hydrocarbons only. Disposal tubes are offshore final oil traps and observation basins are onshore final oil traps.

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Oily water or oil-contaminated water	Waste water generated by the installation and which may contain oil, emulsified oil, or other hydrocarbon contaminants.
Oily water treatment	Facilities designed for the treatment (primary, secondary) of oily water to meet a given specification (maximum oil in water content) for its disposal to sea or to public environment.
Open drains	They are basically atmospheric drains: their intakes (entry points) are permanently open to atmosphere.
Hazardous / Non-hazardous open drain	Hazardous open drains collect waste oily water from hazardous area (i.e. liquid hydrocarbon production and processing areas). Non-hazardous open drains collect waste oily water from non-hazardous area .
Paved areas	Refers to paving, concrete slabs and other liquid tight surfaces required underneath and around the onshore hydrocarbon process equipment (typically 1.5 m for units handling liquid hydrocarbons) to prevent infiltration into the soil of hydrocarbon liquids (and other pollutants likely to spill). Watertight roads inside installation units (e.g. asphalt or bitumen concrete roads or equivalent) are also part of the paved areas.
Primary treatment	Gravity-differential separation of oil from waste and oily waters: API separator or plate separator <u>onshore</u> , or sump tank <u>offshore</u> .
Scupper	Specific to F(P)SO. Openings for draining off water from hull deck to the sea.
Secondary treatment	Facilities designed for the treatment of oily water by means other than gravity-differential separation to meet a given specification (maximum oil content in water) for its disposal e.g. coalescence, flotation, chemically enhanced separation (coagulation, flocculation..) or centrifugal treatments (hydrocyclone, centrifuge...).
Seals, sealed	The “seals” are in this specification hydraulic seals. Drains are “sealed” if they are provided with a hydraulic seal to prevent fire spreading and gas migration. This can be implemented either in the piping (siphon) or by entering a capacity below the liquid level.
Self-contained equipment	Equipment provided with a bund designed for containment of a major accidental leak, this bund is connected to the open drains system via a normally closed valve.
Slop tank	It is specific to floating installation. A tank specifically designated for the collection of tank drainings, tank washing water and oily water drains for a oil-water separation before disposal to sea (which is subject to IMO MARPOL : residual oil content in water, unless noted otherwise). Slope tank on floating installations may fill the same task as Sump tank on fixed offshore installations.

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Sump tank	It is specific to offshore installations. An atmospheric tank designed for oil-water separation according to specific gravity differences, as primary treatment of oily water open drains collected from process areas (OD1 and OD2).
Time of concentration	Water travel time from the most hydraulically remote point of the paved area to the observation basin during a rain event (not necessarily the maximum distance from the outlet).
Toxic fluids	The characteristics of a chemical substance to produce injury by inhalation or contact once it reaches a susceptible site in or on the body. The effects may be acute or chronic, local or systemic (IOGP Report No. 6.52/244). The criteria to define a substance as a toxic fluid are set in applicable local regulations (including the list of Carcinogenic, Mutagenic and toxic to Reproduction (CMR) substances) and in GS EP SAF 253 (for inhalation hazard).
Unpaved areas	Refers to areas other than above defined “paved areas” such as, but not limited to: gravelled areas accessible to pedestrians only, gravelled or unsealed access roads or car parks, undeveloped areas.

4. General description

Drainage systems are fixed networks of hard piping which are used to collect and transfer liquid wastes and escaped liquid hydrocarbons to treatment facilities for safe and controlled disposal (or recycle to the process).

4.1 The different types of drainage effluents

In oil and gas production/treatment installations, there are four types of effluents concerned with drainage:

- **Waste waters**
 - Run-off water (rainfall, fire-fighting and deck/slab washings), polluted or potentially polluted
 - Equipment cleaning water (“jetting”, piping and vessel cleaning prior to inspection or maintenance)
 - Water draw-off from oil storage tank bottoms during dewatering operation
- **Hydrocarbons**
 - Drips and spillage from hydrocarbon process equipment, wireline and other well servicing activity, and other facilities containing oils and greases
 - Sampling
 - Draining of process equipment prior to inspection or maintenance
- **Chemicals**
 - From the laboratory and other analyser houses

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- Chemicals used in oil and gas processes
- **Sewage**
 - Waste waters from domestic areas (galley, laundry, accommodation and sanitary facilities)

4.2 The different drainage networks

4.2.1 Closed drains

Any facility containing hazardous liquids which must be drained for operational reasons and cannot be drained directly to atmosphere (because of the risk of pollution or release of flammable or toxic vapours), shall be connected to a **closed drain** system; in particular:

- Hydrocarbon process equipment or piping operated under pressure
- Equipment containing **toxic fluids** as defined in section 6.6.
- Equipment containing **high volatility hydrocarbon liquids** (Category A fluids)

4.2.2 Open drains

They are atmospheric drains collecting the surface waste liquids. All their intakes (entry points) shall be permanently open to atmosphere.

In normal operation, **open drain** system should receive only a limited amount of liquid hydrocarbons (machinery drips and sampling drainage effluents).

For safety reasons, the direct drainage of facilities containing flashing hydrocarbons, **toxic fluids** or **high volatility hydrocarbon liquids** (Category A fluids) to an **open drain** system shall be avoided.

Units handling **high volatility hydrocarbon liquids** shall not be provided with **open drainage** systems for normal operation.

4.2.2.1 OD1 - Open drains, permanently oil-contaminated

OD1 drains are found in liquid hydrocarbon production, process and storage areas (**hazardous areas**).

OD1 sources include:

- Liquids collected underneath the oil or gas/condensate process equipment likely to produce drips in routine operation e.g. pumps, compressors, vessels, production wellheads, manifolds, sampling devices (excluding Cat. A fluids) and generally all equipment subject to leaks or overflow. Such liquids shall be collected in **drip pans** (API RP 14C).
- Liquids collected underneath oil loading areas including loading arms, hose handling areas at jetties and filling points.
- Water draw-off from oil storage tank bottoms.
- Waste water from oil laboratory and analyser houses (they require an independent collection system, see section 5.10.2).

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OD1 effluents shall be treated in a purposely designed **oily water treatment** unit containing a **primary treatment** unit as a minimum, and if necessary a **secondary treatment** before disposal. Depending on expected quantities, **OD1** waters may be treated on site or stored and transferred for treatment in another facility.

4.2.2.2 OD2 - Open drains, accidentally oil-contaminated

OD2 drains are waste water **open drains** found both in hazardous and **non-hazardous areas**.

OD2 sources include:

- In facilities processing liquid hydrocarbons: waste waters collected in the vicinity of process units i.e. (i) offshore: the deck drains, (ii) onshore: the **paved areas**.
- In facilities not handling liquid hydrocarbons: waste waters collected in areas polluted with lube oils and greases from machines such as power generation, water injection pumps or other equipment (e.g. transformer using insulating oil).
- Waste waters from bunded area and roof of oil/condensate storage tanks.
- Cooling waters that may be polluted with oil.
- Depending on quantity and rate of release, chemicals which have no or a limited impact on environment and which have no adverse effect on oil/water separation (e.g. methanol).

OD2 liquids shall be treated before disposal to the environment, and, as a minimum, floating oil recovered in an **oil trap** (Onshore: an **observation basin**; offshore: an **oily water disposal tube**).

4.2.2.3 OD3 - Open drains, oil-free

OD3 sources include:

- Offshore: Rain water received on the “clean” decks e.g. lay-down areas, peripheral areas outside process and utility modules, and the roofs of modules and shelters.
- Onshore: Rain water received on the green belt, **unpaved areas**, building and shelters roofs.
- **Excess water**, wash water and firewater from **hazardous areas**.
- Water condensed from ambient air in contact with cold process systems.

OD3 water may be discharged directly into the environment (Offshore through an outfall pipe discharging to sea; onshore through a pipe or a ditch discharging to public environment).

4.3 Particular cases

4.3.1 Sampling connections

Typical drawings for sampling connection precisising the destination of each type of effluent should be developed for each new project or major revamping study. As a minimum, the different types of sampling connections should be described in the project-specific operating documentation. Sampling connection arrangements shall be approved by Company representative and shown on a dedicated P&ID legend sheet.

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Samples from a facility containing flashing hydrocarbons or **toxic fluids** shall be collected in a closed, sealed container whose design pressure is equal to or greater than the pressure source, or connected to the **closed drain** system or to a lower pressure process system.

4.3.2 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. Such systems are outside the scope of this specification (see [GS EP CIV 403](#) and [GS EP SAF 221](#)).

5. Segregation principles

The proper segregation of the drainage systems is essential to safety and environment. This chapter is applicable to all closed and open drain types as indicated in chapter 4. In addition, all instrument drains shall comply with the basic principles laid down in this chapter.

5.1 Segregation of closed and open drains

Closed drains shall be segregated from **open drains** in order to prevent pressure-driven gas from the **closed drains** being released into atmosphere via the **open drain** system (no inter-connection at all, even for maintenance purpose).

However the following indirect connections are allowed:

- Offshore: The oil return from the **open drain sump tank** may be pumped to the **closed drain** drum providing the required liquid seal. This configuration shall follow the operation drain requirements (see section 7.4).
- Onshore: An **API separator** or other open pit may receive both liquids from **closed drain** drum and **oily water** from the **open drains**. Liquid **seals** shall be provided at the inlet to counter balance the maximum operating pressure from the **closed drain** drum side. The **open drain** header inlet shall be submerged at least 1 meter below liquid level.

5.2 Segregation by fire zones

The drain systems should be, as far as practicable, segregated per fire zone ([GS EP SAF 253](#)).

Drainage piping crossing two independent fire zones should be avoided.

Where the same drainage system serves different fire zones, **fire breaks/gas seals** shall be installed at the limit in between two fire zones.

The design principles are defined in section 8.5 for segregation of **open drains** per fire zone.

Each fire zone should have its own specific **closed drain** drum which receives the drains from associated process equipment. There should be no connection between **closed drain** drums from different fire zones.

Where the same **closed drain** drum serves more than one fire zone, each fire zone shall be provided with its own header and the inlet of each header into the drum be provided with **dip pipe** of at least 300 mm.

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5.3 Segregation of cold and wet effluents

The collection and treatment of drains are segregated such that icing may not occur: cold drains (handling LNG, refrigerated LPG or NGL) shall be collected independently from wet drains.

5.4 Segregation of LNG, LPG and warm effluents

LNG drains, **high volatility liquids** (e.g. LPG or NGL) drains and other warmer fluids shall be collected separately before they enter the flare drum. Mixing cold drainage effluents with warmers may result in deep vacuum conditions with a potential for piping collapse. In case such mixing is considered inevitable in operation, piping and vessels shall be designed to withstand the resulting vacuum.

5.5 Segregation of maintenance and operation drains

The **closed drain** system should be used for **maintenance drainage** only. **Operation drains** should be avoided: the drainage from live equipment should be done to the production process.

Where **operation drains** are implemented, the Operation drain header shall be connected directly to the **Closed drain** drum through a dedicated nuzzle, independent from the **maintenance drain** headers. In this case, the **maintenance drain** nozzles shall be provided with dip pipe (with a minimum liquid seal of 300 mm) inside the **closed drain** drum.

In case it may not be possible to fully segregate them by design, all **operation drains** shall be temporarily isolated prior to any manual drainage for maintenance.

5.6 Segregation of closed drains based on piping rating

The collection piping should be segregated into sub-systems of different piping classes (150#, 300#, etc.); in that case, each sub-system shall be provided with an independent header connected to the **closed drain** drum via a dedicated nozzle. In absence of operation drain and for **closed drain** drum dedicated to only one fire zone, no dip pipe is required.

5.7 Segregation of hazardous and non-hazardous open drains

The risk of sending hydrocarbons from areas categorised "hazardous" (as per **GS EP SAF 216**) to areas categorised "non-hazardous" shall be minimised by segregation of the drainage systems serving these areas.

The piping networks collecting **open drains** from **hazardous areas** and from **non-hazardous areas** shall be independent (no inter-connection at all, even for maintenance purpose). This principle applies to all **open drains**, including the instrument **open drains**.

Open drain headers from hazardous and **non-hazardous areas** may all discharge into a common atmospheric **oil trap** or **primary treatment** facility provided the two following conditions shall be met:

- Headers from **hazardous areas** are independent from headers from **non-hazardous areas** and each header enters the common treatment facility via its own dedicated inlet nozzle.
- Hydraulic **seals** are provided at the **oil trap/primary treatment** facility (dip pipe, the drain header from **non-hazardous areas** is **sealed** at entry with 1 m water depth minimum).

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5.8 Segregation of drip pans

Generally, **drip pans** or kerbs shall be arranged in order to prevent mixing of drainage effluents that require different treatment methods.

5.9 Segregation of paved areas

Paved areas shall be split into spillage catchment areas:

- Spillage catchment areas should be arranged in order to prevent mixing of effluents that require different treatment methods.
- Spillage catchment areas shall be arranged in order to prevent mixing of effluents that require incompatible methods for vapours control and fire-fighting.
- The location, size and shape of the spillage catchment areas shall be such that the effects of a pool fire of the size of one spillage catchment area can be controlled.

Open drainage systems shall be arranged and sized to prevent flooding of the spillage catchment areas and potential spread of fire and flammable liquids from one catchment area to another or to **unpaved areas**. Segregation of **open drains** based on quality

5.10 Segregation of open drains based on quality

5.10.1 OD1, OD2 and OD3 effluents

The following operation shall be avoided:

- Routing **OD1** effluents to **OD2** or **OD3** network or receiving equipment.
- Routing **OD2** effluents to **OD3**.

It is accepted to route the excess rain and fire water from **OD2** effluents to **OD3** network.

However, **OD2** can be directed to **OD1**, and **OD3** can be directed to **OD1** or **OD2** provided that the **oil trap** or **treatment unit** capacity is sized to take this extra flow into account.

5.10.2 Effluents not compatible with OD1, OD2 and OD3 sources

Drainage effluents that are not compatible with waste waters collected in installation areas (some chemicals), shall not be mixed with **OD1**, **OD2** and **OD3**, without prior adequate treatment.

The drainage effluents which are toxic for health or the environment and cannot be treated on site, shall be stored in adequate sealed containers, and then transported to appropriate treatment facilities outside the installation.

5.10.2.1 Domestic sewage

Domestic waste waters shall not be mixed with other drainage effluents.

5.10.2.2 Laboratory drainage effluents

All laboratory drainage effluents shall be routed to a dedicated laboratory **open drain** tank.

These wastes shall be processed in one of the ways mentioned below in section 5.10.2.3.

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5.10.2.3 Chemicals skids

Chemical injection skids and permanent storage tanks containing hazardous chemicals shall be provided with bunds to safely contain minor leaks and major accidental spillages.

Hazardous drainage effluents from chemical injection skids shall be routed to a dedicated chemical spill tank.

These wastes shall be processed in one of the following ways:

- Either treated locally (equalisation, pH control) or diluted before routing to the main **open drain** system (**OD1**)
- Or stored and shipped to an appropriate treatment facility.

Glycol and Amine units (Absorption units)

The chemical drips of absorption units shall be collected and stored in dedicated sump drums for either recycling to process or dedicated **secondary treatment** if they cannot be re-used.

Onshore storage tanks handling chemicals incompatible with water such as glycol, amines, etc. will have their **bunded areas** drained to **OD2** drain system for rain water wash-off. For minor or major accidental spillage in the tank storage **bunded areas**, these liquids shall be contained by a normally closed drain valve. They shall be removed from the bund sump by vacuum truck and treated separately. Refer to **GS EP ECP 101** for glycol package unit design.

Water contaminated with acids

Such waters shall be collected in a dedicated **open drain** drum and neutralised, as near as possible to the source.

5.10.2.4 Sour water streams

Sour Water streams (e.g. containing H_2S or NH_3) shall be stripped in a Sour Water Stripper column. Further treatment (scavenger injection, neutralisation, pH control) may be necessary before routing to the main **oily water treatment** system.

5.10.2.5 Water containing agents that can impair gravity separation

Streams that can impair gravity separation, such as streams containing solids, emulsifying agents and/or contaminants that tend to flocculate upon dilution shall:

- Be segregated from **oily water**.
- Be treated and/or disposed of separately, as specified by Company within the projects.

For example, the "jetting" waters which are used to clean vessel internals to prevent accumulation of sands and sediments fall into this category. A specific collecting network, independent from the other **open drains** is provided. Jetting waters are washed and filtered before joining **OD2** drains.

The drilling modules at onshore well pads are also in this category, where the rainwater is subject to contamination by chemicals and drilling mud. A special drainage system shall be provided to collect and handle the contaminating drains from the rig cellar surrounding, cement production and loading area, and mud production (pre-treatment, temporary storage) and loading area.

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Refer to section 10.6 for the specific case where **F(P)SO slop tanks** are used as **open drain sump tank**.

5.10.2.6 Oily water from Machinery space

For environmental purposes, **oily waters** from machinery spaces, containing lube oils with metallic contents, are handled separately from other oils. This segregation shall be addressed in the project-specific Safety Concept.

6. General design requirements

The design of the drainage systems should minimise the presence of stagnant hydrocarbon mixtures (liquids, emulsions, and solid residues) on surfaces (**paved areas**, decks) and inside the collection system.

Evacuation of drainage effluents shall be by gravity.

In onshore installations, **paved areas** shall be provided in process areas in order to:

- Prevent infiltration of oily drainage effluents into the soil.
- Minimise the evaporation rate of liquid hydrocarbons, and thus the extent of the flammable gas cloud that will form in case of loss of containment.

The system shall be designed to prevent any flooding of **paved areas**, floors or decks around control rooms, technical rooms (containing instrument or electrical equipment) and furnaces.

Restrictions, fittings and generally piping routings with a high resistance to flow should be avoided.

Maximum capacity of **open drain** horizontal headers shall be in accordance with **GS EP CIV 202**.

6.1 Piping diameter

The nominal diameter of main drainage headers, open and closed, in onshore and offshore installations shall not be less than 3". Refer to **GS EP ECP 103** for the line sizing.

For onshore **OD3**, minimum nominal diameter shall be 4" on distances up to 4 m and 6" on distances more than 4 m.

6.2 Piping gradients

6.2.1 Fixed installations

The minimum gradients for horizontal piping are specified below for fixed installations (for gravity-type drains, non-flooded pipes). The hook-up tolerances have to be taken into account for prefabricated modules. For sewage piping, refer to **GS EP CIV 202**.

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Type of installation	Line size	Minimum gradient
Onshore	$\varnothing \geq 18''$	0.2%
	$18'' > \varnothing \geq 6''$	0.4%
	4''	1%
	3''	1.25%
Offshore	$\varnothing \geq 3''$	1%

6.2.2 Floating units

Higher gradients than specified in section 6.2.1 may be required on floating units. The pipes used for gravity flow shall:

- Be designed with sufficient slopes to prevent backflow under certain loading configurations resulting in static tilt (list or trim).
- Take into account the effect of pitch and roll depending on system and criticality.

6.3 Branch connections

The branch connections on headers should be 45° to 60° in direction of the stream in order to minimise turbulences and emulsions. 90° connections are acceptable where the risk of forming emulsions is low.

The risk of plugging of the **open** and **closed drain** headers with solids (sand, etc.), deposits (wax, drilling mud, etc.) or high viscosity fluids or hydrate plugs, if any, shall be identified in the project-specific Safety Concept.

Where the risk of blockage remains high, the following shall be provided:

- Rodding points, in particular at each 90° connection (if any) and at the end of the main headers
- Flushing connections and facilities

Reference is made to Figure 3.

6.4 Material selection

The drain systems material selection shall be validated by Company's corrosion specialist.

Steel and GRP piping could be used. Reference is made to [GS EP COR 005](#), [GS EP PVV 112](#), [GS EP PVV 178](#) and [GS EP CIV 202](#).

6.5 Underground facilities

All buried sections shall be welded (no flanges); particular attention should be given to the vessel nozzles by placing them in a separate valve/flange pit with restricted access.

Onshore tanks and vessels handling liquid hydrocarbons should preferably be installed aboveground. Where installation underground or below grade level cannot be avoided, the vessel/tank shall be installed in an excavated pit to minimise the risk of an unnoticed leak to the environment, see Appendix 1 Figure 1-J as example (non prescriptive).

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6.6 Toxic service

The limit of toxic release shall be considered for all toxic materials e.g. SO₂, CO, CO₂, Cl₂, disulfides, mercaptans, BTEX (Benzene, Toluene, Ethylbenzene and Xylene), etc. (refer to [GS EP SAF 253](#)) in the drainage effluents are:

- In adequately ventilated areas: **IDLH** (Immediately Dangerous to Life and Health) of the toxic material in the gas on release⁽¹⁾
- In inadequately ventilated areas⁽²⁾: **TLV TWA** (Threshold limit Value - Time Weighted Average) of the toxic material in the gas on release

Notes:

- (1) The “gas on release” is the gas flashing from the process liquid at atmospheric and ambient temperature.
- (2) With regards to toxic materials, an area is defined as **inadequately ventilated** when the ventilation (natural or artificial) is not sufficient to prevent the accumulation of significant quantities of the toxic component -Air mixtures in excess of their TLV TWA (definition from [API RP 55](#)). Typical examples are pits and depressions. For further guide refer to [GS EP SAF 216](#).

For example, the IDLH and TLV TWA of H₂S are respectively 100 ppm and 5 ppm, molar.

The maximum acceptable concentrations in the gas on release shall be validated by Company.

Facilities handling such toxic streams shall be provided with appropriate utilities to flush, purge and inerting.

6.7 Heat tracing

If the minimum ambient temperature can result in freezing and wax deposition, drainage lines, seal pots and headers shall be winterised by heat tracing or alternate solutions.

Piping and vessels in LPG drainage systems prone to contain water shall be heat traced.

7. Design of closed drains

7.1 General

Closed drain systems are designed for the collection of **maintenance drains**. **Closed drain** lines shall slope continuously down to the **closed drain** drum without any low points and no pockets in the piping.

Maintenance drains are connections used to drain process equipment or piping once it has been shutdown, isolated and depressurized. **The residual pressure before maintenance drainage to the closed drain system shall not exceed 3.5 barg.**

Operation drains are connections between process equipment or piping and the **closed drain** system, which can be operated whilst the unit is in service (with all associated risks). **Operation drains** are considered process systems and their design shall follow the [GS EP ECP 103](#). The implementation of **operation drains** shall be limited (low operating pressure, remote location, intermittent and infrequent liquid discharge, small quantities) and justified and the impact on production availability evaluated.

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Where **operation drains** are deemed necessary, the following risks shall be mitigated:

- Over-pressurization due to **gas blow-by**
- Over-filling of the **closed drain** system
- Interference with manual drainage operations and the risk of back flow from high pressure drains towards low pressure drains

A dedicated HAZOP review (as per [API RP 14C](#) and [IEC 61882](#)) shall be conducted, and the results thereof analyzed, to confirm the design of **operation drains** is safe and operable.

All **operation drains** shall be highlighted on the P&ID's (with a note describing their design intent) and in the project-specific Operating Philosophy.

The above rules related to **operation drains** shall also apply to Vendor packages.

7.2 Design parameters of Piping and collection network

Reference is made to [GS EP ECP 103](#).

7.2.1 Design pressure

The **closed drain** connection shall be fully rated for the highest design pressure connected to, at least up to the last isolation valve on the flow path.

The **closed drain** headers shall be rated to match the highest design pressure of the process facilities to which they are connected **except for those which are positively isolated** from the process system during normal operation. For the aforesaid positively isolated collection systems, the typical rating of the headers is 150# (**GRP** or metallic), in accordance with [GS EP COR 005](#), [GS EP PVV 112](#) and [GS EP PVV 178](#).

7.2.2 Design temperature

The **closed drains** shall be designed for the minimum design temperature of the process equipment and the maximum design temperature of the process fluid.

The **closed drains** that are not positively isolated from the process during normal operation shall also be designed for the temperature produced by **gas blow-by** situation.

7.3 Maintenance drains connections

7.3.1 General arrangement

The connection of a **maintenance drain** to a process facility shall be designed as per the drawings of Figure 1, and according to the fluid category.

Branches connecting the process facilities (e.g. hydrocarbon piping and vessels) to **closed drain** headers shall be:

- Of a 2" nominal diameter, as a minimum.
- Fitted with a full bore ball valve located as close as practicable to the process component.