



Exploration & Production

GENERAL SPECIFICATION

SAFETY

GS EP SAF 228

Liquid drainage

Main Instructor for Derogation: ECP (Process)

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1. Scope

1.1 Purpose of the specification

GS EP SAF 228 defines the safety requirements for **liquid drainage** facilities in the petroleum installations of the upstream segment of COMPANY's activities in order to minimise uncontrolled spillage and risk of hydrocarbon ignition and subsequent fire escalation.

The design of oil-contaminated drains, **open drains** and **closed drains**, from process, storage and utility areas is the main subject of this **GS EP SAF 228**. These drains are designed to handle liquid wastes produced in **normal operation**, any degraded operating modes foreseen during design, and maintenance.

GS EP SAF 228 also addresses the collection and containment of accidental spillage from facilities processing hydrocarbon liquids.

GS EP SAF 228 also aims to minimise direct discharge of polluted streams to the environment by channelling them to appropriated treatment units, in line with COMPANY Environmental requirements as per **GS EP ENV 001**.

1.2 Applicability

New installations designed by or on behalf of COMPANY shall comply with this specification. 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 of the installation.

GS EP SAF 228:

- Is not retroactive, but it is used as a reference during the design and operability reviews of the existing oil and gas installations operated by COMPANY affiliates.
- Applies to all onshore and offshore fixed installations handling hydrocarbon liquids in the upstream segment of COMPANY activities, including those handling liquefied gases.

GS EP SAF 228 does not cover:

- Hydrocarbon gases and vapours disposal facilities (covered by **GS EP SAF 262**)
- Treatment of production water (i.e. water from reservoir) and utility waters (e.g. cooling water, desalting water)
- 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 oily water to the environment
- Design of the facilities treating the 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 (addressed in **GS EP INS 900**).
- The mobile marine facilities covered by the codes issued by the IMO (International Maritime Organisation)

- The petroleum installations of the COMPANY downstream segment i.e. refinery, marketing and petrochemicals.

The design features that are specific to F(P)SO installations (Floating, (Production) Storage and Offloading) are addressed in **GS EP STR 651**, and only addressed in this document where additional clarification is necessary.

The drawings and figures contained in this specification are illustrative only and should not be regarded as detailed engineering documents. They illustrate some of the points made in the specification and should be used as a basis for the preparation of detailed engineering drawings.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
Not applicable	

Professional Documents

Reference	Title
ISO 10418 / API RP 14C	Petroleum and natural gas industries Offshore production installations Basic surface process
ISO 13703 / API RP 14E	Petroleum and Natural Gas Industries - Design and Installation of Piping Systems on Offshore Production Platforms
ISO 17776 / API RP 14J	Petroleum and Natural Gas Industries - Offshore Production Installations - Guidelines on Tools and Techniques for Hazard Identification and Risk Assessment
ISO 14620	Space Systems - Safety Requirements
API RP 55	Recommended Practice for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide
ISO 23251 / API RP 521	Petroleum, petrochemical and natural gas industries Pressure-relieving and depressuring systems

Regulations

Reference	Title
NFPA 59A	Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)



Codes

Reference	Title
IP Code, Part 15	Area classification code for petroleum for installations, part 15 of the Institute of Petroleum Model Code of Safe practice (March 1990)

Other documents

Reference	Title
	Statement Of Requirements (SOR) Safety Concept Operating Philosophy

Total General Specifications

Reference	Title
GS EP CIV 202	Drainage and underground networks
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 diagrams
GS EP PVV 112	Piping material classes
GS EP SAF 216	Area classification
GS EP SAF 253	Impacted area, restricted area and fire zones
GS EP SAF 261	Emergency Shut-Down and Emergency De-Pressurisation (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 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.
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 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. Its use is to be avoided, unless it is necessary to describe a sequence of events.

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

API separator	Gravity-differential type oil-water separator and auxiliaries designed according to API recommendations. 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 bundwalls 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.
Classified/Unclassified open drains	Classified open drains collect waste oily water from hazardous area (i.e. hydrocarbon liquid production and process areas). Unclassified open drains collect waste oily water from non hazardous area .
Closed drains	Closed drains are fully contained drains, hard piped from the equipment to be drained to the treatment facilities.
Cold Flare	A cold flare system collects and disposes of cold/dry effluents which are not compatible with warm/wet effluents.
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) designed to collect, contain and send to the installation drains the oily drips (hydrocarbons, oils, greases) likely to occur underneath process equipment and machines in 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 .

Fire break / gas seal	U-shaped siphon whose low point is normally filled with liquids, aimed at preventing fire and gas propagation between two different segments of an open drains piping system
GRP	To designate the Glass Reinforced Plastics used in the fabrication of 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 IP Code, Part 15).
High volatility hydrocarbon liquids	Those hydrocarbon liquids which are referred to as Category A petroleum fluids. The criteria for categorising flammable liquids "A" as per the IP code are given in GS EP SAF 216 . Basically all liquefied methane and ethane (LNG), all liquefied propane and butanes (LPG), and the more volatile of the rest of Natural Gas Liquids (NGL) belong to this category.
HP flare or HP vent	A HP flare or HP vent is a disposal system where the back pressure can be higher than that what is admissible in the LP relief system. The HP flare collects the high flowrate sources which cannot be routed to the LP flare disposal system because they would create excessive back pressure.
Impounding basins	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 basins stand-by are located adjacent to the process equipment, not underneath. Not to be confused with drip pans and bunded areas .
LP flare or LP vent	A LP flare or LP vent is a disposal system where the back pressure must be maintained low (maximum 3.5 barg) even at maximum relief flowrate.
Maintenance drains	Closed system which collects liquid drains from depressurised equipment and piping. The system is used for maintenance purpose only.
Minimum installations	Installations handling oil and gas for production or transport purposes, with no processing facilities. Offshore, they are the wellhead and/or manifold platforms which are not bridged to a process installation. Onshore they are the wellhead clusters and/or production manifolds. A minimum installation may include helideck, (dry) firewater network, electrical cabin, etc. Test separators and pig traps are not considered as processing facilities. Well-Head Platforms or clusters with FWKO drums and water degassing drums 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 waters. It is an open pit designed as to retain the drainage effluent for a certain time.

(OD1) Permanently oil-contaminated drains	Waste water open drains contaminated in normal operation by significant quantities of liquid hydrocarbons.
(OD2) Accidentally oil-contaminated drains	Waste water open drains : • either (1) contaminated in normal operation or during other routine operations foreseen during design (e.g. maintenance) by very small volumes of hydrocarbons so that it is acceptable environmental-wise to route directly the effluents directly to an observation basin or a disposal tube without first separation in API separator or sump tank. • or (2) normally clean and for which contamination with hydrocarbons can only result from an accidental leak (e.g. piping weld puncture) or a rare event (e.g. storm flooding and cross-contaminating normally clean areas).
(OD3) Oil-free drains	Waste water open drains in areas where the risk for contamination by hydrocarbons is minimal and can be disregarded.
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.
Oily water or oil-contaminated water	Waste water generated during the industrial process and which contains oil, emulsified oil, or other hydrocarbons.
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 waters.
Open drains	They are basically atmospheric drains: their intakes (entry points) are permanently vented to atmosphere.
Operational drains	Closed system which collects liquid drains from process equipment and piping whilst the process unit is live and the process equipment and piping is at normal operating pressure.
Paved areas	Refers to paving, concrete slabs and other liquid tight surfaces required underneath and around the onshore hydrocarbon process equipment to prevent infiltration into the soil of hydrocarbon liquids (and other pollutants likely to spill).
Primary treatment	Gravity-differential separation of oil from waste waters: API separator onshore, or sump tank offshore.
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 to sea or public waters: e.g.: filtration, flotation, chemical flocculation and biological treatment.
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.
Sump tank	Atmospheric tank designed as a gravity-differential oil-water separator to treat offshore oil and gas installations oily water drains from the hydrocarbon production and process areas.
Toxic fluids	The characteristics of a chemical substance to produce injury once it reaches a susceptible site in or on the body. The effects may be acute or chronic, local or systemic (OGP). The criteria to define a substance as a toxic fluid are set in applicable local regulations and in GS EP SAF 253 .

4. Design principles for liquid drainage (closed and open drains)

This chapter addresses the basic COMPANY requirements for the design of liquid drainage systems.

4.1 The different liquid drainage systems

Drainage systems are networks of pipes collecting liquid wastes from numerous intake points in catchment areas, and transferring these liquids to treatment facilities before safe and controlled disposal (or recycling these liquids into the processing plant).

4.1.1 The different types of 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 not
 - equipment cleaning water ("jetting", line and vessel cleaning)
 - storage water (settling)
- **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 before maintenance
- **Chemicals**
 - from the laboratory and other analyses houses
 - chemicals used in oil and gas processes
- **Sewage**
 - Waste waters from domestic areas (galley, laundry, accommodation and sanitary facilities).

4.1.2 The different configurations of drainage networks

4.1.2.1 Closed drains

Any facility containing hazardous liquids which need to be drained for operational reasons and may not be drained directly to atmosphere without undue risk to personnel, environment or assets from release of flammable or toxic vapours, shall be connected to a **closed drain** system. In particular:

- Hydrocarbon process equipment and/or piping operated under pressure
- Equipment containing **toxic fluids** as defined in section 4.8
- Equipment containing **high volatility hydrocarbon liquids** which require draining for maintenance / inspection purposes.

The design of **closed drains** is detailed in chapter 5.

4.1.2.2 Open drains

They are basically atmospheric drains collecting the surface waste liquids: all their intakes (entry points) are permanently vented to atmosphere.

For safety reasons the facilities containing hydrocarbon flashing fluids under pressure, **toxic fluids** or **high volatility hydrocarbon liquids** shall **not** be drained to an **open drain** system.

4.1.3 Particular cases

4.1.3.1 Instrument drains

The design features that are specific to instrument drains are addressed in **GS EP INS 900**.

The nominal size of instrument drains is normally much smaller than vessel and piping drains.

All instrument drains shall however comply with the basic principles laid down in sections 4.2 and 4.3.

Note that vessel standpipe drains shall be regarded as vessel/piping drains and therefore shall comply with this specification, whereas level glass should be regarded as instrument drains.

4.1.3.2 Sampling

For each new project or major revamping, sampling typicals should be developed. As a minimum the Operating Philosophy and/or Safety Concept documents should list the different types of sampling facilities to be implemented. Sampling typicals shall be approved by Company representative and shown on a dedicated P&ID.

Samples from a facility containing hydrocarbon flashing fluids under pressure, **toxic fluids** shall not be connected to the **open drain** system. They shall be collected in a closed, **sealed** container rated to match the facility maximum operating pressure, or if necessary connected to the **closed drain** system or to a lower pressure process system.

4.2 Effluent categories in open drains

4.2.1 Open drains, permanently oil-contaminated (OD1)

OD1 drains are found in hydrocarbon liquid production, process and storage areas.

OD1 waters 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.

OD1 sources include :

- Liquid collected underneath the oil or gas/condensate process equipment likely to produce drips in routine operation (e.g. pumps, compressors, vessels, HC wellheads, manifolds, sampling devices and generally all the equipment with a concentration of non-welded fittings). Such liquid shall be collected in a **drip pan**.
- Liquid collected underneath oil loading areas including loading arms, hose handling areas at jetties and filling points
- Water draw-off from oil storage tank bottoms
- Water from oil laboratory and analyser houses (they require an independent collection system, see section 4.2.4)
- Drainage from oil sample points (not of fluid cat. A)

4.2.2 Open drains, accidentally oil-contaminated (OD2)

They are waste water **open drains**.

Before disposal to the environment, OD2 waters shall be treated and, as a minimum, floating oil recovered in an **oil trap** (offshore: an **oily water disposal tube** designed as per section 8.5.2, onshore: an **observation basin** designed as per section 7.1.1).

OD2 sources include :

- In plants processing hydrocarbons liquids: waste waters collected in the vicinity of process units i.e. (i) offshore: the deck drains, (ii) onshore: the **paved areas**.
- In plants not handling hydrocarbon liquids: 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), subject to segregation requirements set in section 4.2.4.8.
- Oil and condensate storage tank bunds waste waters
- Cooling waters that may be polluted with oil

4.2.3 Open drains, oil-free (OD3)

OD3 water may be discharged directly into the environment (offshore through an outfall pipe discharging directly to sea, onshore through a pipe or a ditch discharging directly to public waters)

OD3 sources include :

- Offshore: the “clean” decks e.g. lay-down areas, peripheral areas away from the process equipment (e.g. outside process and utility modules), and the rooves of modules and shelters
- Onshore: the green belt, undeveloped areas, building rooves (buildings outside the process area).

4.2.4 Effluents not compatible with OD1, OD2 and OD3 sources

This section lists the main types of wastes encountered in oil and gas production and treatment facilities that shall not be mixed with waste waters collected in the installation **open drains** without prior adequate treatment.

The 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.

4.2.4.1 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 or disposed of before appropriate treatment.

4.2.4.2 Laboratories

Laboratory sink drains handle oily products but also chemically polluted effluents, which shall not be sent directly to the installation **open drain** system. The laboratory drains shall be piped independently from other drains to a dedicated, vented atmospheric tank.

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

- Treated (**secondary treatment** like neutralisation), or
- Stored before transport to an appropriate treatment facility.

The solution should be selected depending on the regulatory requirements and plant design. The selected design shall be approved by COMPANY.

4.2.4.3 Chemical storage

Permanent storage containing hazardous chemicals incompatible with water shall be provided with bunds to safely contain minor spillage and major accidental leaks. The contained spillage should then be treated (e.g. using one of the methods defined in section 4.2.4.2). The method selected shall be approved by COMPANY.

4.2.4.4 Sour water/Chemically polluted streams

Sour Water streams (e.g. containing H₂S or NH₃) shall be stripped in a sour water stripper, unless otherwise specified by COMPANY. Further treatment may be necessary before they can be discharged to the main **oily water treatment** system.

Units handling:

- Methanol, glycol, amines

More generally any chemical that cannot be separated by gravity from wastewaters, shall not be drained to the installation **open drain** system. Their wastewaters and drips shall be collected and stored independently for further handling (e.g. recycling to the process, dedicated **secondary treatment**).

4.2.4.5 Water contaminated with acids

Such waters shall be neutralised, as near as possible to the source.

4.2.4.6 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:

- Not be mixed with **oily water**
- Be treated and/or disposed of separately, as specified by COMPANY.

Falling in this category are the “**jetting**” **waters** which are used to clean vessel internals to prevent accumulation of sands and sediments. A specific collecting network, independent from the other **open drains**, shall be provided. Jetting waters shall be washed and filtered before allowing them to drain in the installation **OD2** drains.

4.2.4.7 Cold drains

Drainage of cold effluents which, mixed with wastewater at ambient temperature, may lead to icing shall be collected in dedicated piping. Treatment, de-oiling, should also be performed in dedicated facilities, unless it is demonstrated that mixing cannot lead to icing in the equipment shared by the cold and humid effluents.

4.2.4.8 Machinery space

Many regulations and best practices require that, for environmental purposes, **oily waters** from machinery spaces, involving lube oils with metallic contents, are handled separately from other oils. This segregation shall be addressed in the Safety Concept.

4.2.5 High volatility hydrocarbon liquids

High volatility hydrocarbon liquids shall not be drained to an **open drain** system. For the containment of accidental spills from facilities containing such liquids refer to chapter 9.

4.3 Segregation

As shown in section 4.2, drainage systems carry a large number of different effluents. Improper segregation of drainage systems is one of the main causes of accidents in oil and gas installations. Segregation must therefore be incorporated as early as possible in the design of drainage systems.

4.3.1 Segregation: Closed drains/Open drains

Closed drains shall **always** be segregated from **open drains** in order to prevent pressure-driven gas from the **closed drains** coming back up into the plant via the **open drains** system.

The piping networks collecting **closed drains** and **open drains** shall be independent (no inter-connections at all, even for maintenance purposes).

The **closed drain** drum shall receive no effluents from the **open drains** collection network. The **closed drain** drum shall not discharge into an atmospheric enclosure (tank, drum) receiving **open drain** effluents.

4.3.2 Segregation: Hazardous/Non hazardous areas

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 systems draining these areas.

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

Drain headers from hazardous and non-hazardous areas may all discharge into a common **oil trap** or **primary treatment** facility provided both conditions below are met:

- Headers from **hazardous areas** are not connected to 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 by means of an inlet pipe discharging below the liquid level in the facility (the drain header from non-hazardous areas shall be **sealed** at entry with 1 m water depth minimum).

4.3.3 The segregation requirement for drip pans

A **drip pan** shall be provided underneath every process and utility facility likely to pollute waste water during routine operation.

Generally catchment areas should be arranged in order to prevent mixing of effluents that require different treatment methods.

Open drainage systems shall be arranged and sized to prevent flooding of the **drip pans** and the spread of fire and flammable liquids from one catchment area to another. There shall be no carry-over:

- From the **drip pans** to the adjacent deck (offshore) or grade (onshore)
- From one deck to the deck located below (offshore).

To achieve this, the **open drain** systems shall be capable of handling the design flows which are defined in section 6.2.

The arrangements of **OD1, OD2, OD3** drains are detailed in chapter 7 for onshore installations and chapter 8 for offshore installations.

4.3.4 The segregation requirement for paved areas

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

- Prevent infiltration of oily effluents into the soil
- Minimise the evaporation rate of hydrocarbons liquids and thus the extent of the flammable gas cloud.

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 non compatible 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. The fixed and mobile active fire-fighting systems, and the passive fire protection of equipment and structures shall be defined accordingly.

Open drainage systems shall be arranged and sized to prevent flooding of the spillage catchment areas and the spread of fire and flammable liquids from one catchment area to another. There shall be no carry-over:

- From one spillage catchment area to the adjacent spillage catchment areas
- From paved to unpaved areas

4.3.5 The segregation of cold / wet effluents

The collection and treatment of drains shall be segregated such that icing may not occur: cold drains (handling LNG, refrigerated LPG or NLG) shall not be mixed with wet drains.

4.4 Drainage piping: diameters, gradients, miscellaneous

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

Evacuation of drainage effluents shall be by gravity. Drainage headers are normally laid horizontally with sizes and gradients in order to ensure proper evacuation. The **open drain** systems shall be capable of handling the design flows defined in section 6.2.

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

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 (special rules apply to **closed drains**, see chapter 5).

Other than siphons and seal pots (or manholes onshore), drainage headers shall contain no pockets and slope continuously towards the **primary treatment, oil trap or sump tank**.

4.4.1 Piping diameter

Piping diameters depend on service (see chapter 5 for **closed drains** piping diameter and chapter 6 for design velocities in **open drains** piping).

The nominal diameter of drainage headers, open and closed, in onshore and offshore installations shall not be less than 3".

Onshore the minimum nominal diameter of **oily water open drain** headers shall be in accordance with **GS EP CIV 202**, 4" for branches less than 15 m and for headers collecting a maximum of 4 drains, otherwise it shall be 6" minimum. A minimum of 8" is required for drainage sewer between manholes (sub headers).

4.4.2 Piping gradients

The minimum gradients of the horizontal piping are specified below for fixed installations (for gravity-type drains, non-flooded pipes):

Type of installation	Line size	Minimum gradient
Onshore	$\varnothing \geq 18''$	0.2%
	$18'' > \varnothing \geq 6''$	0.4%
	$6'' > \varnothing \geq 3''$	1.25%
Offshore pre-fabricated module	$\varnothing \geq 3''$	1% + hook-up tolerances
Offshore	$\varnothing \geq 3''$	1%

Note that F(P)SO may require higher gradients to make up for vessel movements.

4.5 Drainage piping: connections to closed drains and to OD1 or OD2 headers

The level of risk of plugging of the open and **closed drain** headers by solids (sand etc.), deposits (wax etc.) or high viscosity fluids shall be identified where credible in the Safety Concept.

Based on this, the type of connection from drain branches or sub headers to drain headers can be made either:

- At 90 degrees, but in this case rodding points shall be provided for each header at risk
- At an angle of 45 or 60 degrees.

4.6 Drainage piping: material and rating

Drainage piping material and rating shall be selected as per specification **GS EP PVV 112**.

4.6.1 Closed drains

The piping material shall be steel, either carbon or alloy depending on service.

GRP (Glass Reinforced Plastics) shall not be used for this service. For pressure ratings refer to chapter 5.

4.6.2 Open drains

Piping shall be class 150# ANSI.

Oil-contaminated water **OD1** and **OD2** drains piping material should be either steel or **GRP** depending on service.

Oil free water **OD3** drains piping material should be either **GRP**, concrete or steel.

Oil-free water may be collected in open channels/ditches.

4.7 Underground facilities (onshore)

Tanks and vessels handling hydrocarbon liquids shall not be installed in excavated pits.

When installation underground or below grade level is necessary, the gap between the facility and the pit shall be filled with dry sand, and suitable protection against rain shall be provided.

Burying those tanks and vessels may be an acceptable alternative only if :

- They are of a double containment fabrication type to minimise the risk of an unnoticed leak to the environment

and if

- They are provided with suitable protection to avoid rainwater percolation.

4.8 Toxic service

Substances regarded as toxic shall not be exposed to personnel without due precaution being taken.

Process streams containing hydrogen sulphide (H₂S) are regarded as toxic and shall not be released intentionally to atmosphere if any one of the following conditions is met:

- The concentration of H₂S in the gas on release ⁽¹⁾ is 100 ppm ⁽²⁾ or more,
- In inadequately ventilated ⁽³⁾ areas the concentration of H₂S in the gas on release is 5 ppm ⁽⁴⁾ or more.

A similar approach shall be adopted for other toxic material (e.g. SO₂, CO, CO₂, Cl₂, disulfides, mercaptans, BTEX, refer to [GS EP SAF 253](#)), for which concentration in the gas on release shall be validated by COMPANY.

- Facilities handling such toxic streams shall:
- Not be drained to an **open drain** system

Be drained to a **closed drain** system.

(1): The "gas on release" is the gas flashing from the process liquid at atmospheric and ambient temperature.

(2): Corresponding to the IDHL of H₂S (Refer to [GS EP SAF 253](#)).

(3): With regards to H₂S concentration, an area is defined as **inadequately ventilated** when the ventilation (natural or artificial) is not sufficient to prevent the accumulation of significant quantities of H₂S-Air mixtures in excess of 10 ppm (definition from [API RP 55](#)). For example areas with 100% plain walls **and either** 100% plain ceiling or 100% plain floor shall be regarded as inadequately ventilated. Typical examples are pits and depressions. For further guidance on areas inadequately ventilated refer to [GS EP SAF 216](#).

(4): Corresponding to the TLV TWA of H₂S (refer to [GS EP SAF 253](#))

4.9 Winterisation

Where applicable, drainage lines, seal pots and headers shall be winterised against freezing by heat tracing or alternate solutions.

4.10 Accidental spillage

Provisions for mitigating the effects of an accidental spillage should be considered below and around any facilities containing combustible, flammable liquids.

These provisions are widely dependent on the type of the liquid, the type of the facilities, their size and inventory, and their location. It is not the purpose of this present document to give detailed solutions for all cases.

The specific case of onshore facilities handling highly volatile hydrocarbons is further addressed in chapter 9. The specific case of hydrocarbon storage is addressed in **GS EP SAF 341**. Toxic and environmentally harmful liquids are addressed in section 4.2.4. For others fluids the general principles are:

- A kerb of minimum 150 mm high should be provided around the area under the equipment where potential leakage could occur. This kerbing area could encompass more than one vessel, depending on the layout of the plant. The area contained within the kerbing shall take into account the estimated flow-rate and volume of the liquid lost during a credible event
- In a consistent manner with **GS EP SAF 253**, the credible leak should be based on a 20mm hole size and a release duration of 10 minutes (see section 6.2.5)
- Onshore the liquids caught in the kerbed area should preferably be routed to a dedicated **impounding basin** via open ditches and by gravity flow. Alternatively these liquids can be connected to the **open drain** system.
- Offshore the liquids caught in the kerbed area shall be routed to the **open drain sump tank** as shown in Appendix 3, Figure 3C.
- Finger-type slug catchers shall be provided with a **paved area** underneath their liquid bottle sections. This **paved area** shall slope to an **impounding basin** whose capacity shall accommodate the maximum liquid volume of the slug catcher, and which is not located underneath the slug catcher.

5. Design of closed drains

5.1 Maintenance and operation drains

Closed drains shall be designed as per the requirements set out in chapters 4 and 5.

Closed drain systems are principally designed for the collection of **maintenance drains**, but can be designed for **operational drains** with the provisions given below.

5.1.1 Maintenance drains

The **closed drain** system connects drains used for maintenance purposes, i.e. to drain a facility after it has been isolated and depressurised (the residual pressure before drainage shall not exceed 3.5 barg).

These **closed drains** shall be referred to as **maintenance drains**.

5.1.2 Operation drains

Liquids from process equipment are routed to other process units.

It may be accepted to route liquids from process equipment to the **closed drains** system only where transferring these liquids to process facilities is impractical e.g.:

- Facilities which would produce small liquid volumes at very low pressure in remote locations (e.g. vent and flare piping low points on some onshore installations)
- Facilities which would release very small liquid volumes infrequently (e.g. compressor casing drains to sweep liquids out before starting, fuel-gas filters).

Automatic transfer of liquids from a flare KO drum to the **closed drain** drum may be accepted if gas blow-by and high level in the **closed drain** drum safeguards are in place. A dedicated nozzle should be provided on the **closed drain** drum.

These **closed drains** shall be referred to as operation drains.

Manual **operation drains** (i.e. that can be operated only manually) shall be justified by Project in an auditable document.

Automatic **operation drains** (i.e. that can be operated without operator manual intervention) shall require a derogation to this specification duly approved by COMPANY.

All operation drains shall be highlighted on the P&ID and in the project OPERATING PHILOSOPHY: a note shall state their design intent.

The above rules related to **operational drains** shall also be applied to VENDOR packages.

5.2 Piping

The lines collecting **closed drain** effluents are referred to as **piping** in this chapter.

5.2.1 General

Closed drain piping shall comply with COMPANY hydrocarbon piping specifications (refer to **GS EP PVV 112**), in particular buried sections shall be all-welded (no flanges).

Closed drain lines shall slope continuously down to the **closed drain drum** (see section 5.3). There shall be no low points in the piping.

All the consequences of a gas blow-by scenario (effect on drain line design temperature and pressure, and effect on flare/vent line diameter from the **closed drain** drum, and safety distances around flare/vent) shall be considered in the design of **closed drains** not positively isolated from the process equipment to which they are connected.

- Positive isolation can be a spectacle blind (in closed position), a blind flange or a removable spool piece.

Care shall be taken that back pressure from high pressure drains cannot impair low pressure drains and their connected equipment.

The **closed drains** not fitted with positive isolation should be carefully considered; these are :

- The operation drains
- Some of the **maintenance drains** (see section 5.2.5 and Figure 1).