

DEP SPECIFICATION

DRAINAGE SYSTEMS AND PRIMARY TREATMENT FACILITIES

DEP 34.14.20.31-Gen.

February 2017

DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design and engineering of onshore gravity based drainage systems and primary treatment facilities. The drainage systems addressed are Clear Rainwater, Accidentally Contaminated, Continuously Contaminated, Open Drip and Drain and Domestic Sewage.

This DEP is not intended to cover Closed Drains (CD) and process Waste Water (WW) streams which usually require secondary and tertiary treatment facilities. CD and WW streams typically contain hydrocarbons/chemicals and dissolved contaminants such as H₂S, NH₃, COD, BOD, high TDS effluents and/or amines.

Effective treatment of effluents requires adequate segregation at the source. This DEP is key to integrating drainage systems and primary facilities with secondary and tertiary treatment facilities.

Guidelines relating to safety and typical requirements during various project development phases are included so that these aspects are accommodated during the relevant design stage.

Well designed, constructed managed and maintained drainage and primary treatment facilities are important for safety and environmental care. Shortcomings in drainage, primary treatment systems and drainage management can lead to unnecessary expenditure arising from the need to install and operate secondary water treatment facilities.

Although this DEP is intended for new construction projects, it is equally applicable to extensions of existing facilities. This DEP is not intended for plant revamp work and/or upgrading works, but it should be consulted to understand the relevant safety and environmental standards, especially in relation to DEM1.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual (DEM) 1 - Application of Technical Standards.

This is a revision of the DEP of the same number dated February 2015; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to oil refineries, chemical plants, LNG plants, LNG receiving terminals, onshore exploration and production facilities and supply and distribution installations or depots. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Specific definitions

Term	Definition
Catchment Area	A catchments area is defined as the area containing all the drainage networks within the same classification and that have the same end of pipe treatment facility or buffer facility (e.g., all drainage networks that discharge into the CDF or all drainage networks that discharge into the CPI).
Channel	Channels are open flow drainage components without covers (either solid or grated). The interior finish (surface exposed to the flow contents) of a channel depends on the contents, the conditions of flow and location. The word 'channel' is synonymous with "ditch" or "swale".
Drainage Network	Drainage networks are a combination of (segregated) catchment areas within the same classification.
Drainage Network Components	Drainage network components include surface drainage components, pipes, sumps, collection pits, funnels and manholes. These assets convey effluent from the source to and between treatment facilities. Sometimes these are called conveyance components.
Drainage System	A drainage system is a combination of drainage networks.
Dry Weather Flow	Effluent being discharged through a drainage network during dry weather (i.e., when there is no precipitation) (e.g., pump seal oil coolers, steam traps, bundle cleaning areas, workshop effluents, once through sample coolers).
Effluents	Effluents are defined as clean or contaminated (surface water) streams that are discharged via a CR, DS, AC, CC or ODD drainage network and may or may not be controlled or treated before they are discharged to public water. In this DEP effluents can include CR (i.e., non contaminated).

Term	Definition
Firebreaker	A firebreaker is a gap in the exposed surface area of a liquid system (combustible material) that acts as a barrier to stop the progress of a surface fire.
Firetrap	A firetrap is a liquid filled component which provides a barrier to the progress of a fire through a piped system
First Flush	The amount of effluent arriving at the CDF as a result of the 'first rain' after a relatively dry period. This first flush is collected (and considered contaminated) as it has collected all (unnoticed) spills from surfaces in the facility. The amount is quantified by using the Time of Concentration (T_c) which is defined as the time required for water to flow from the most distant point of the catchment area under consideration to the point of investigation.
Funnel	A special type of sump used in ODD or CD systems. If located above grade a funnel is an exposed conical or bowl shaped sump with a vertical pipe outlet. However, if located below or at grade, a funnel is a small 'sump' with a single liquid sealed horizontal pipe outlet.
Invert Level	The height above/below a benchmark of the lowest part of a pipe or network at a given point in the drainage system. It refers to the level of the floor of the pipe on the inside, not the base of the pipe on the outside. In a manhole or sump, the invert level, is taken to be the lowest point (floor) within the manhole or sump. Within a tank compound or pipetrack the invert level also refers to the floor level.
Liquid Gas Trap	A liquid gas trap is a liquid (water) filled sump which prevents liquefied gas (e.g., LNG) from entering into an underground drainage network.
Manhole	A flow component device that connects two or more underground pipes and is designed to allow for inspection and maintenance access to the undergrounds. Manholes are installed at each change in direction (vertical or horizontal), each change in diameter and at intersections of main drainage lines (e.g., connection of two or more lines).
Paving	Paving is any hard surfacing used to facilitate the drainage of surface runoff to a collection network (e.g., concrete, pavers, asphalt). In (potentially) contaminated surfaces (AC and CC) paving is impermeable, in CR areas paving may be permeable. (Compacted) gravel, sand, grass, are not considered paving.
Primary treatment	Primary treatment is the step of the water treatment process based on the difference in density of the polluting substance and the medium carrying it, the former being removed either by rising or settling over a given time. It is gravity based treatment and used primarily to remove 'free-floating' hydrocarbon' droplets and suspended solids from effluent streams.
Primary Treatment Facilities	Primary treatment facilities are gravity separators which provide an environment in which suspended solids can settle out coincidentally with segregation of fluids with a different density (e.g., insoluble hydrocarbons and water). Examples of such facilities are interceptors, separators and basins.

Term	Definition
Public Water	Public water is all common water such as rivers, lakes, the sea or ocean, but can also be groundwater or a public domestic sewer system.
Secondary Treatment	Secondary treatment comprises of more complex steps of water treatment based on chemical and/or biological action or enhanced gravity separation. It is used to remove unwanted suspended solids, oil, grease and dissolved contaminants from effluent streams. Secondary treatment (facilities) are not addressed in this DEP.
Splitter Box	A splitter box is a flow diversion basin/facility located upstream of a facility of which the capacity is less than required to deal with the peak flow. The splitter box diverts the excess flow to an alternative network or buffer facility.
Sub-catchment Area	Sub-catchments areas are those areas segregated by high points within a catchment area, which altogether make up the overall catchment area.
Sump	Sumps collect effluents from the connected sub-catchment area and discharge the effluent via gravity flow through underground pipes or via a pumped system. The word 'sump' in this DEP is synonymous with "catch basin"
Tertiary Treatment	Tertiary treatment includes levels of treatment beyond secondary treatment. Tertiary treatment could include suspended solid removal, dissolved solid removal (such as phosphorous and nitrogen compounds) or removal of toxic chemicals and heavy metals and/or to meet the compliance with toxicity bioassay. Tertiary treatment is also called "polishing". Tertiary treatment is typically applied to improve the water quality such that the effluent can be reused. Tertiary treatment (facilities) are not addressed in this DEP.
Trench	The term 'trench' is used to designate covered channels. All trenches shall be provided with continuous covers appropriate for the surface design load conditions (e.g., heavy duty grating, concrete tiles).

1.3.3 Abbreviations

Term	Definition
AC	Accidentally Contaminated
BOD	Biological Oxygen Demand
CC	Continuously Contaminated
CD	Closed Drain
CDF	Controlled Discharge Facility
COD	Chemical Oxygen Demand
CPI	Corrugated Plate Interceptor
CR	Clear Rainwater
CW	Cooling water
DMP	Drainage Master Plan
DS	Domestic Sewage
EO	Ethylene Oxide
FFB	First Flush Basin
FFW	Fire fighting Water
GRE	Glass-fibre Reinforced Epoxy
GRP	Glass-Fibre Reinforced Plastic
H ₂ S	Hydrogen Sulfide, 'sour gas'
HDPE	High Density Polyethylene
HSSE&SP	Health, Safety, Security, Environment & Social Performance
NH ₃	Ammonia
ODD	Open Drip and Drain
TDS	Total Dissolved Solids
POB	Peak Overflow Basin
PVC	Poly Vinyl Chloride
UPVC	Unplasticised Polyvinyl Chloride
WMP	Water Management Plan

Term	Definition
WW	Process Waste Water

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (11).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated February 2015. The following are the main, non-editorial changes.

Section/Clause	Change
All	Combined multiple SHALL [PS] requirements into a central SHALL [PS] requirement thereby avoiding duplication.
All	Converted the requirements for a Water Master Plan into the requirement for Drainage Master Plan.
All	Restructured the DEP providing a more practical specification.
All	Removed internal duplication and/or conflicting requirements.
All	Added an appendix describing the drainage related deliverable during the various design stages.
All	Updated the following standard drawings to correct inconsistencies, include improvements and ensure alignment with the content of this DEP.
All	The following Standard Drawings have been updated for alignment with this DEP. S 14.050, S 14.051, S 14.052, S 14.053, S 14.054, S 14.055, S 14.056, S 14.057, S 14.058, S 14.060, S 14.061, S 14.064, S 14.066, S 14.067, S 14.069.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://swwww.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

2. DESIGN PROCESS AND DELIVERABLES

2.1 DESIGN PROCESS

1. The design of the drainage system shall be carried out in stages in line with the Opportunity Realisation Process.
2. During the design, any conflict between the project documentation or local standards that result in conflict with this DEP shall be highlighted, and along with a proposed action plan for resolution submitted to the Principal.

2.2 DRAINAGE MASTER PLAN

1. A Drainage Master Plan (DMP) shall be developed for each facility and meet all of the following:
 - a. tie-in to and be in compliance with the assets/projects Water Master Plan (WMP);
 - b. address the plant/facility related specific drainage requirements in relation to the minimum requirements of this DEP;
 - c. classify all drainage streams as per classification defined in Table 3;
 - d. demonstrate the existence of segregated drainage networks and controlled discharge of the effluents in line with the HSSE & SP requirements of the Principal;
 - e. demonstrate the effort to optimize the amount of effluent to be collected, by:
 - i. prevention at the source;
 - ii. classification and subsequent segregation and/or combination of effluents.
 - f. provide a definition of the primary treatment requirements of the facility;
 - g. reference specifications, drawings and calculations which demonstrate compliance with the requirements of this DEP.

A WMP is normally developed for a project/plant. This WMP addresses all water streams within the plant/facility (inclusive of process water).

The WMP describes the overall water system inclusive of drainage systems and primary treatment facilities at a high level and typically contains/addresses the following main topics:

- *Integrated flow scheme. An example integrated flow scheme is shown on Standard Drawing S 14.050;*
- *Process and utility water integration where appropriate;*
- *Secondary and tertiary treatment facilities;*
- *Industrial water preparation/treatment such as boiler feed water.*

3. DESIGN BASIS

3.1 HSSE & SP

3.1.1 General

Safety in design is enhanced by attention to detail in pipe-to-pipe joints, joints of pipes to sumps, and in the covers of open channels and sumps.

1. Drainage systems at operating facilities shall be designed and installed in accordance with Principal's HSSE & SP Control Framework.
2. AC, CC and ODD network components as well as associated primary treatment facilities SHALL [PS] be considered as hydrocarbon containing equipment.
3. For the assessment of the fire safety of onshore installations, see DEP 80.47.10.30-Gen.
4. For active fire protection systems and equipment for onshore facilities, see DEP 80.47.10.31-Gen.
5. All outfalls to the public water shall meet the requirements (quality and temperature) of the authority having jurisdiction.
6. The drainage system shall:
 - a. contain barriers to prevent transmitting a fire from one area to another via the underground or surface drainage system (3.1.2);
 - b. provide adequate capacity to handle the design load conditions (3.2);
 - c. be designed and maintainable such that the components maintain functional integrity for the design life of the facility.

One element of functional integrity is the ability for the drainage system to measurably demonstrate that it is a barrier to prevent the release of contaminants above that which is permitted by regulatory or design requirements to public waters, soil or groundwater.

3.1.2 Fire propagation prevention in AC, CC and ODD networks

1. Fire propagation in between (sub) catchment areas, plants/units and within AC or CC pipetracks SHALL [PS] be prevented by means of firebreakers combined with liquid filled firetraps.

Such firebreaker and firetrap combinations in AC and CC networks are preferably achieved by means of liquid filled horizontally laid underground piping. As an alternative, isolated firetrap and firebreaker combinations (e.g., appropriate upturned or downturned elbows, firebreaker in a local sump) can be proposed.

In ODD networks fire propagation is typically prevented by isolated firetraps (e.g., appropriate upturned or downturned elbow) draining into a liquid filled underground network or into a vessel located at or near the battery limit of the plot area.

2. Sand traps in AC and CC networks SHALL [PS] be provided upstream of a firetrap and at the lowest point in a trench or channel.
 - a. The traps shall have the same width as the drain channel and a minimum length of 2 m (6 ft - 6 in) and a minimum depth of 0.5 m (1 ft - 8 in).
3. The liquid head in fire traps (e.g., upturned or downturned elbows, liquid filled networks or network components) shall be:
 - a. 100 mm (4 in) in arid climates (3.13):
 - i. this may be reduced to 50 mm (2 in) if a priming system (make up water) is implemented.
 - b. 50 mm (2 in) in all other climates.

Typical details of a sand and firetrap are shown in Standard Drawing S 14.051 and S 14.053.

3.1.3 Control of VOCs and flammable vapour from effluents

1. Sealed manholes SHALL [PS] be one of the following:
 - a. vented to a 'classified safe area' (subject to regulatory framework in relation to emissions);
 - b. vented to vapour destruction equipment such as a flare, thermal oxidiser or carbon canister.
2. Primary treatment facilities that require control of VOC and/or flammable vapour SHALL [PS] be one of the following:
 - a. vented to a 'classified safe area' (subject to regulatory framework in relation to emissions);
 - b. vented to vapour destruction equipment such as a flare, thermal oxidiser or carbon canister;
 - c. purged/blanketed.
3. Vent pipes SHALL [PS] not result in any direct connection between different compartments of a sealed manhole.
4. Vent pipes shall meet all of the following:
 - a. be constructed of suitable plastic material (e.g., polypropylene or polyethylene) or carbon steel:
 - i. 100 mm (4 in) diameter if length is <10m (33 ft);
 - ii. 150 mm (6 in) diameter if length is > 10 m (33 ft) and < 25 m (82 ft).
 - b. have the centre of the inlet opening 150 mm (6 in) below the cover plate.
5. The vapour vent design shall be submitted to the Principal for approval.