

DEP SPECIFICATION

DRAINAGE SYSTEMS AND PRIMARY TREATMENT FACILITIES

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(DEP Circular 55/11 has been incorporated)

DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements for the design and engineering of drainage systems and primary treatment facilities.

The scope for this DEP includes open and closed gravity based drainage and primary treatment systems. This applies to onshore drainage and treatment facilities.

This DEP is intended to provide the user with a specification that will improve standards for good design and engineering practice for drainage and primary treatment facilities whilst emphasizing the importance of integrating these facilities with secondary/tertiary treatment facilities such as flocculation flotation units (FFU) and biotreaters – known as secondary treatment facilities.

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

The importance of well designed, constructed managed and maintained drainage and primary treatment facilities cannot be overstressed, in terms of safety and environmental care. Shortcomings in drainage and primary treatment systems and management can have significant impact on process safety and the environment and can result in significant and unnecessary expenditure for the installation of secondary water treatment facilities and their operating costs.

Although this DEP is intended for new construction projects, it is equally applicable to any extensions of existing facilities. It is not intended for revamp work and/or upgrading works, but may be consulted to comply with all required safety and environmental standards.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application to technical Standards.

This is a revision of the DEP of the same number dated January 2010; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil refinery, chemical plant, LNG plants, LNG receiving terminals, onshore exploration and production facilities and supply and distribution installations or depots. It is not written for parts of modular facilities where drainage is incorporated in the module, or for permafrost regions. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process should 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 preferred solution.

1.3.2 Specific definitions

Term	Definition
Primary treatment	is the step of water purification 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 used primarily to remove 'free floating oil' droplets from effluent streams.
Secondary treatment	comprises complex steps of water purification based on chemical and/or biological action or enhanced gravity separation. It is used to further remove unwanted suspended solids, oil and grease and dissolved contaminants from effluent streams.
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. Tertiary treatment is also called "polishing". Tertiary treatment is typically applied to improve the water quality such that the effluent can be reused.
Oil	The word ' oil ' in this DEP is synonymous with the word "dispersed hydrocarbon" and "hydrocarbon components" from process or storage sources.

1.4 ABBREVIATIONS

AC	Accidentally Contaminated
BOD	Biological Oxygen Demand
BOD ₅	Biological Oxygen Demand [measured after 5 days at 20° C (68 °F)]
CC	Continuously Contaminated
CDF	Controlled Discharge Facility
COD	Chemical Oxygen Demand
CPI	Corrugated Plate Interceptor
CR	Clear Rainwater
CW	Cooling water
FF	First Flush
FFB	First Flush Basin

FFU	Flocculation-Flotation Unit
FFW	Fire Fighting Water
HSE	Health, Safety and Environment
JSA	Job Safety Assessment
LLOD	Last Line of Defence
ODD	Oil drip and drain
PO	Peak Overflow
POB	Peak Overflow Basin
RA	Risk Analysis
TS	Task Statement
WMS	Work Method Statement

1.5 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced by this DEP are listed in (6).

1.6 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated January 2010. The main changes involve separation of informative content into a companion DEP informative document and a review of the process safety requirements.

1.7 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.8 DUAL UNITS

**Amended per
Circular 55/11**

Dual units have been incorporated throughout this DEP.

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.

2. DESIGN

2.1 HEALTH, SAFETY AND ENVIRONMENT (HSE) IN DESIGN

2.1.1 GENERAL

Deleted.

2.1.2 HEALTH IN DESIGN

The minimum requirements for the management of health related matter in companies where Shell has operational control is mentioned in Minimum Health Management Standards, a component of the Shell Group Standards for Health, Safety, Security and Environment, which states that compliance with national statutory requirements is mandatory for all aspects of health management.

2.1.3 SAFETY IN DESIGN

2.1.3.1 General

Drainage systems at operating facilities shall be designed and installed in accordance with Shell standards. This approach ensures that plant safety is not impaired by the drainage systems and that the systems primarily do not facilitate safety hazards such as the propagation of fire or gas from one area to the next should a plant fire break out.

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. If further reference or clarity is needed on a specific issue not covered by this DEP, the Principal shall be consulted.

2.1.3.2 Prevention of fire propagation

All detailed elements of the drainage networks SHALL [PS] be in accordance with the following:

Element	Requirement
AC and CC Headers	- Horizontally laid; - Liquid-filled with a minimum head of 50mm - Liquid-filled with a minimum head of 100mm for dry areas (dry defined as the arid climate criteria B of the Koppen-Geiger climate classification system)
Firetraps	Required to isolate one plant area from another and should always be at road crossings
Open drain channels on plant process areas	- Minimum length - Design as shallow as possible before entry into the underground piping network via sumps or manholes - Self draining and comply with the gradient requirements set out in section 2.4.4.3
Pipe sizes less than 150mm in diameter (small pipe size)	Liquid seals are required for continuously contaminated gravity drain systems by means of appropriate upturned or downturned elbows.

2.1.3.3 Prevention of hydrocarbon vapour build up

Hydrocarbon vapour buildup shall be relieved. Sealed sumps or manholes SHALL [PS] be vented to a 'classified safe area' (2.1.3.4). When definition of 'classified area' is unclear, these sumps / manholes SHALL [PS] be vented to location higher than nearest structures. The Principal shall approve this design interpretation.

For a sealed sump with more than one compartment, vent pipes SHALL [PS] not result in any direct connection between the different compartments.

2.1.3.4 Area classification

Area classification drawings shall be consulted. Primary water treatment facilities SHALL [PS] be considered as hydrocarbon containing equipment and their location SHALL [PS] be subject to the minimum safety distances as per IP15 (referenced in DEP 80.00.10.10-Gen).

Sumps and manholes that may contain flammable liquid or hydrocarbon SHALL [PS] maintain minimum safety distance of 15.0 m (50 ft). from any ignition source.

Prevailing winds and meteorological conditions shall be taken into consideration when choosing the location and orientation of the treatment facility.

2.1.4 ENVIRONMENT IN DESIGN

2.1.4.1 General

Deleted.

2.1.4.2 Spill control

Locations that are prone to leakage, such as joints between two pipes, and joints between pipes and sumps themselves SHALL [PS] be paid special attention during design (construction and inspection) to eliminate leakage.

Specific requirements for spill control shall be determined in conjunction with the Principal.

2.1.4.3 Volatile organic compounds

If covers are deemed necessary for primary treatment facilities (thus leading to potential build up of VOCs (Volatile Organic Compounds), they shall be properly ventilated or purged to a safe area to ensure a safe operating environment for operators.

2.1.4.4 Erosion control

All materials for the construction of drains shall be resistant against hydrocarbons and erosion for velocities as specified in section 2.4.5.1.1. For clear rainwater (CR) outside process area, earth ditch may be permitted, but appropriate design and maintenance effort shall be taken to avoid excessive erosion and discharge of muddy water to public water.

The outfall of a drainage system shall be designed in a manner to provide protection against local erosion and erosion due to turbulence at outfall.

2.2 WATER MASTER PLANNING

2.2.1 INTRODUCTION

To achieve compliance with Shell Group and local legislative requirements in a sustainable economical climate, and in the drive to conserve or establish the possible reuse of water, the approach of Water Master Planning has been developed and refined over the years. The Water Master Planning process at operating sites is essential to establish cost effective investments in effluent collection networks, effluent treatment facilities and industrial water preparation facilities.

A water master plan (WMP) shall be developed and incorporate the following main topics:

- 1) Surface drainage and primary treatment facilities;
- 2) Process and Utility water integration;
- 3) Secondary treatment facilities;
- 4) Sludge handling and disposal.
- 5) Industrial water preparation

This DEP deals only with the surface drainage networks and primary treatment facilities and their relation with the other treatment facilities which are an integral part of the Water

Master Plan. This DEP focuses on the integration of surface water drainage and primary treatment water facilities with more enhanced secondary treatment facilities, and tertiary treatment (in case of water reuse).

A typical integrated flow scheme for a master plan is shown in Figure 1 below.

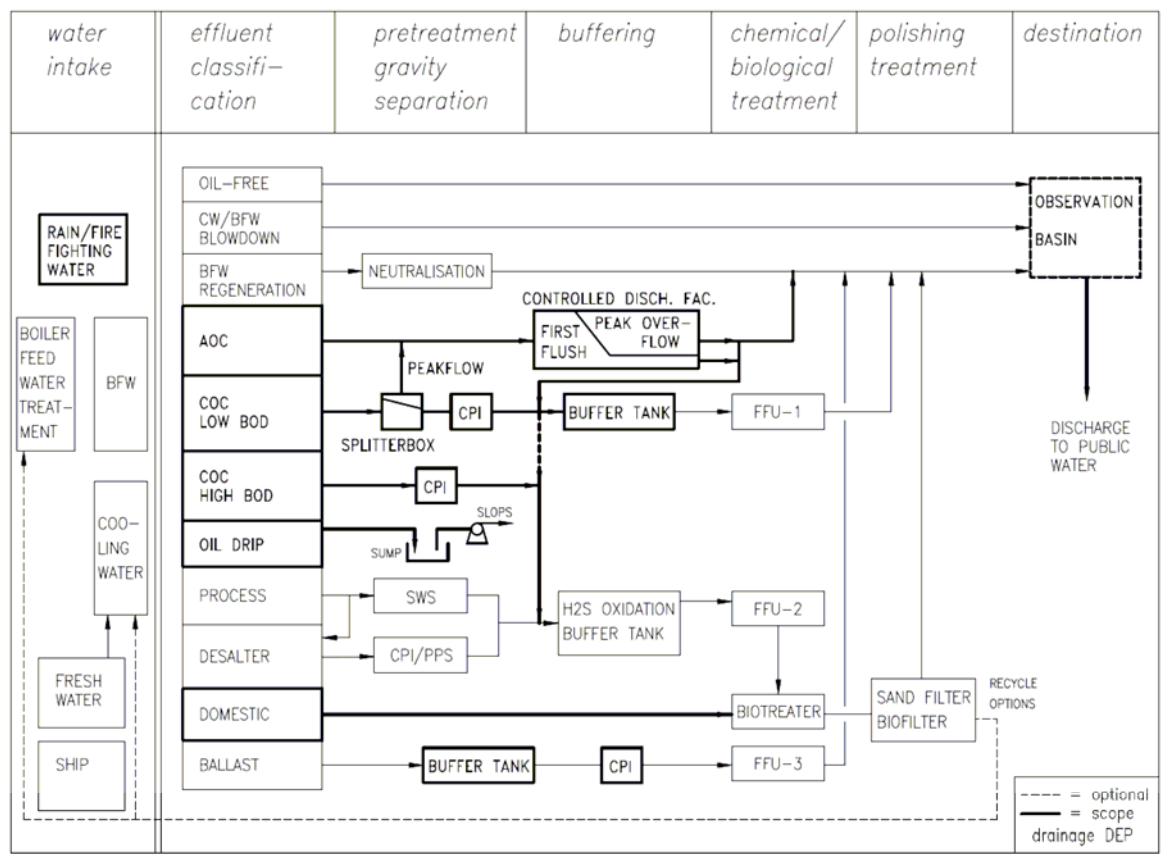


Figure 1 Typical Integrated Flow Scheme (Standard Drawing 14.050)

2.2.2 OBJECTIVE OF WATER MASTER PLAN

The objectives for the water masterplan activities for drainage and primary treatment are:

- Controlled discharge of surface water in line with the Shell Global Environmental Standards, i.e. local requirements and World Bank Group Requirements, whichever of the two is most stringent;
- Minimise/optimize amount of effluent to be sent for treatment, by
 - o Prevention at the source;
 - o Inventorisation and classification of effluent streams;
 - o Segregation of streams.
- Definition of the minimum treatment requirements for the various non-process effluents;
- Effective primary water treatment facilities, optimally integrated with other water streams (i.e. as part of the water master plan)

An important aspect of the water master plan is to map and classify all effluent / water streams on basis of contaminant load and type of contaminations (solids, oil and biodegradable components) and toxicity. On basis of classification a decision can be taken

as to whether full secondary treatment is required or whether simple gravity oil/water separation, e.g. primary treatment is sufficient.

Proper segregation of streams in the drainage system will reduce the hydraulic and contaminant load for secondary treatment. The different categories of effluent water have been included in section 2.3.

2.3 EFFLUENTS

2.3.1 GENERAL

Effluents are defined as (contaminated) water streams that are discharged via process drains, equipment drains and surface drains and may or may not require treatment before they are either discharged to public water or, in certain instances, reused.

Dependent upon their source, type and level of contamination, effluents shall be classified into various categories. From each category, the required drainage network and eventual treatment facility shall be determined.

The segregation of all effluent streams shall, where possible start at the source, the preference being to reduce contaminant loading upstream in order to minimize treatment requirements downstream.

2.3.2 EFFLUENT SOURCES

The following sources of effluents can be identified at operating facilities and shall be considered as applicable, for new designs and or existing upgrades:

- a) rainwater
- b) fire fighting water and/or foams
- c) wash down and/or flush water
- d) cooling water blowdown and filter backwash tank bottom drains
- e) floating tank roof drainage
- f) equipment drains
- g) sampling points
- h) desalter drains
- i) accidental spillages of crude or hydrocarbon products
- j) maintenance operations (e.g. exchanger bundle pulling, pump seal replacement)
- k) domestic sewers
- l) ships' ballast water
- m) cooling water return
- n) Steam condensate
- o) Water from ground seepages or springs
- p) Dewatering systems (e.g. for construction)
- q) Groundwater management systems

2.3.3 EFFLUENT CLASSIFICATION

For new designs effluents SHALL [PS] be classified as belonging to one of the following categories in Table 1.

Principal shall be consulted when doubt exists on the eventual classification of any effluent.

Table 1 Effluent Classifications

Classification	Typical stream
Clear Rainwater(CR) - CR areas consist exclusively of areas where surface rainwater cannot be contaminated by hydrocarbons or chemicals.	• surface water run off from clean areas, • raw water filtration bleed, demin effluent, boiler blow down, cooling water;
Accidentally Contaminated water (AC) - the AC system collects mainly surface water from all areas not designated as CR as well as other water streams, which normally meets the required water effluent specifications but could be on occasion contaminated	• surface water run off from tank farms, roads, process areas, • cooling water blowdown;
Continuously Contaminated water (CC) - this includes effluent from continuous sources that contain significant percentage of hydrocarbons that do not meet the required water effluent specifications	• low BOD: ballast water, crude tank bottom drainage, surface water run off from "dirty" process areas; • high BOD: tank bottom drainage from product/slops tanks, Process water containing Oil and dissolved contaminants: see process water.
Domestic sewage	
Oil drip systems	• atmospheric system for 'non-hazardous' service; • closed drip system for hazardous services 'hazardous' service;
Process water containing Oil and dissolved contaminants as H ₂ S, NH ₃ COD, BOD	• sour water; • desalter effluent;
High TDS effluents	• spent caustic.
Amine contaminated streams	• Amine spills in LNG facilities (Amine unit)

2.3.4 EFFLUENT ROUTING

Effluents SHALL [PS] be routed by means of drainage networks or in some instances, permanent hard piping, to selected treatment facilities and/or discharge points.

The selection of the routing for the effluents SHALL [PS] be determined in conjunction with the plant layout requirements and the process and environmental specialists responsible for the water/effluent treatment processes.

Typical destinations for effluents are:

- a) Non-process effluents
 - i. CR: direct to public water without treatment.
 - ii. AC: to a controlled discharge facility with further treatment requirements based on discharge quality requirements.
 - iii. CC: to either a pre-separator, followed by an interceptor (e.g. CPI) to secondary treatment or directly to a buffer tank and a secondary treatment unit or directly to a collection sump.
 - iv. Once through cooling water return: via a controlled discharge facility to public water.
 - v. Domestic sewage: to a dedicated sewage treatment plant or biotreater

- facility.
- vi. Open oil drips/drain effluents ('non-hazardous'): to collection sumps and recovery.
 - vii. Ships tanks washings: dependent upon salt content, to buffer tank and secondary treatment
- b) Process effluent networks
- Process effluents from selected processes: to dedicated treatment facilities;
 - Closed Oil drips/drain effluent ('hazardous'): to dedicated recovery vessels and recycling.
- c) Chemical effluents
- Chemically polluted effluent streams: to dedicated secondary treatment facilities or for recovery and reprocessing in the process streams.
 - Effluent streams contaminated with acids: to a neutralization pit/tank located as near as possible to the source of effluent discharge, with dedicated downstream treatment.
 - Effluent streams containing solids, emulsifying agents, and contaminants that tend to flocculate upon dilution: treated and disposed of separately.

For a diagrammatic summary of standard forms of effluent classification and routing, refer to Standard Drawing 14.050.

2.4 DRAINAGE NETWORKS

2.4.1 General

Drainage networks shall be suitable for collecting and conveying specific effluents and run-offs from catchments and sub-catchments and designed such that optimum segregation of the different effluent streams is achieved. The associated resultant flows shall meet the specified end-of-pipe requirements through primary treatment as necessary.

The most efficient and practical routing of networks shall be selected to discharge effluents to the appropriate 'end-of-pipe' treatment facility.

Typical networks to be considered for plant areas shall be defined under three main categories, namely:

- a) **Non-process effluent drainage networks such as;**
- i. CR;
 - ii. AC;
 - iii. CC;
 - iv. Cooling return/blow down;
 - v. Domestic sewage;
 - vi. Open Oil drips/drain collection (for 'non-hazardous' service, atmospheric).
- b) **Process water effluent drainage networks such as;**
- i. Desalter drains
 - ii. Process equipment drains
 - iii. Closed Oil drips/drains collection (hazardous service, usually pressurized)
 - iv. Acidic effluent streams
 - v. Heavy emulsion streams
- c) **Chemical effluents**