



Exploration & Production

GENERAL SPECIFICATION

ENVIRONMENT

GS EP ENV 421

Landfill design and operation for E&P sites

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1. Scope

1.1 Purpose

The purpose of this General Specification is to define the general requirements for the design, construction and operation of landfills necessary to manage waste generated on E&P sites.

1.2 Applicability

This General Specification applies to all affiliates and projects managed by the E&P branch, where a landfill is deemed necessary to manage waste generated during facilities construction or on operational exploration and production sites.

It shall be used for landfills built for Company use, whoever the landfill operator may be: Company or Contractor.

For landfills built to manage waste from other generators outside Company, some requirements may be considered not relevant. All required deviations from the present specification shall be managed under a derogation process.

The provisions included herein shall be applied in the absence of more stringent local regulations or standards.

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
ISO 5667-1	Water quality - Sampling - Part 1: Guidance on the design of sampling programmes and sampling techniques
EN 13257/A1	Geotextile and geotextile-related products - Characteristics required for use in solid waste disposals
EN 13967/A1	Flexible sheets for waterproofing - Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheet - Definitions and characteristics
EN 13984/A1	Flexible sheets for waterproofing - Plastic and rubber vapour control layers - Definitions and characteristics



Professional Documents

Reference	Title
Report No. 413	Guidelines for waste management with special focus on areas with limited infrastructure, OGP, Rev 1.1, September 2008 (updated March 2009)

Regulations

Reference	Title
Directive 1999/31/EC	Of the Council of 26 April 1999 on the landfill of waste
Directive 2008/98/EC	Of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives
40 CFR, Part 273	Code of Federal Regulations-Title 1: Protection of the Environment, Standards for universal waste management

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP ENV 001	Environmental requirements for projects design and E&P activities
GS EP ENV 111	Baseline study environmental status of an onshore site
GS EP ENV 120	Environmental impact assessment for E&P activities

3. Terms and definitions

Waste, hazardous waste, non-hazardous waste, inert waste: refer to **GS EP ENV 001**.

Biodegradable waste means waste capable of undergoing anaerobic or aerobic decomposition.



Landfill means a waste disposal site for the deposition of waste onto or into land, including internal waste disposal sites (i.e. landfills where a waste producer is carrying out its own waste disposal at the site of production). Facilities excluded are those where waste is temporarily stored in order to permit its preparation for later transport to other recovery, treatment or disposal facilities elsewhere, and temporary (i.e. less than one year) waste deposition prior to recovery, treatment or disposal.

Landfills are usually classified in one of three categories depending on the type of waste accepted: hazardous waste, non-hazardous waste, and inert waste ([Directive 1999/31/EC](#)).

Treatment means the physical, chemical or biological processes, including sorting, that change the characteristics of the waste in order to reduce toxicity or volume, to facilitate its handling or enhance recovery.

Leachate means any liquid percolating through the deposited waste and emitted from or contained within a landfill.

Landfill gas (or biogas) means gas generated by the anaerobic decomposition of organic waste; it is a mixture of methane and carbon dioxide, plus trace gas constituents.

Liner, geomembrane, or geosynthetics are generic term for all synthetic membranes used in geotechnical engineering.

Mineral barrier is the bottom portion of a landfill, composed of a low hydraulic conductivity clay layer that confines the waste and prevents leachate escape.

Composite barrier is the addition of a mineral barrier and a liner.

Drainage layer means a high hydraulic conductivity portion of a landfill base (or final cover) that promotes the movement of liquids, usually away from the impermeable layer.

Groundwater monitoring well means a small groundwater piezometer used to measure the water level and quality of the water bearing horizon. They are usually not more than 50 m deep.

Hydraulic conductivity is a coefficient of proportionality describing the rate at which water can move through a permeable medium. The density and kinematic viscosity of the water must be considered in determining hydraulic conductivity.

4. General principles

As per [GS EP ENV 001](#), waste generated during Company's works and operations, shall be clearly identified, classified (at least as hazardous and non-hazardous) and quantified to allow their adequate collection, segregation, temporary storage, treatment and disposal.

A list of typical E&P waste with associated classification is provided in [GS EP ENV 001](#).

Treatment and disposal options shall be selected in accordance with local regulations, taking into account the 5 R principles" waste management hierarchy ", i.e.: Reduce, Recover, Reuse, Recycle, Residue disposal.

When landfilling has been identified as some waste preferred disposal option, the site selection, facility design and operating conditions shall be defined in accordance with the present specification. [Report No.413](#) should also be taken as reference.

Company may decide to subcontract landfill operation as well as engineering and construction. Company remains responsible for its waste, from generation to final disposal, even if it uses the services of a Contractor.

During the early stage of the landfill construction project, Company shall ensure that Environmental baseline study (EBS) and Environmental impacts Assessment (EIA) are carried out (GS EP ENV 111 and GS EP ENV 120).

Company shall ensure that landfill is adapted to the nature and quantities of waste, and to the environmental context, and that the proposal for the landfill construction contains at least the following requirements:

- A description of the types and total quantity of waste to be deposited
- The proposed capacity of the disposal site
- A description of the site, including its hydrological and geological characteristics
- The proposed methods for pollution prevention and abatement
- The proposed operation, monitoring and control plan
- The proposed plan for closure and aftercare procedures.

Company shall also ensure that all the regulatory permits required for the landfill construction and operation are granted.

5. Types of wastes concerned

5.1 Wastes categories

The landfill may accept both hazardous and non-hazardous waste.

Should both hazardous and non-hazardous waste need to be disposed of at the same location, the landfill shall contain separated cells, one or more for each waste category.

Except otherwise stated by Company, inert wastes are normally excluded, their disposal being considered on a case by case basis, and under less stringent conditions than for hazardous and non-hazardous wastes.

5.2 Restrictions to waste disposal

The following wastes are not allowed to be disposed of into the landfill:

- Liquid waste
- Wastes which, in the conditions of landfill, are explosive, corrosive, oxidizing, highly flammable or flammable
- Medical wastes which are infectious
- Radioactive wastes, except NORMS which may be accepted under specific conditions which shall be strictly defined and approved through a derogation process
- Any other type of waste which does not fulfill the acceptance criteria which shall be agreed with Company
- Hazardous wastes such as pasty and oily material shall not be disposed of into the landfill, unless they have received a preliminary treatment to enhance their cohesion, for example by stabilization with lime (CaO) and/or cement, at ratio depending on oil content. Acceptance criteria should include parameters such as dryness and hazardous components content in leachate.

6. Landfill design

6.1 Site location

Landfills can be natural, topographic depressions and/or man-made excavations formed of earthen material. A key consideration for a landfill site is the guaranty to provide long-term containment. (Report No. 413).

The location of a landfill shall take into consideration requirements relating to:

- Distances from the site boundary to residential, recreation areas and waterways, water bodies and other agricultural or urban sites, ensuring a minimum separation of 0.5 km from residential areas
- The existence of a superficial aquifer, coastal water or protected areas
- The geological and hydrogeological conditions in the area
- The risk of flooding, and site instability
- The protection of the natural or cultural patrimony in the area.

The landfill can be authorized only if the characteristics of the site with respect to the above mentioned requirements, or the corrective measures to be taken, indicate that the environmental risk associated to the landfill is acceptable.

The landfill shall be located so that wind borne matter (dust, paper, etc.) from the site is not dispersed onto public roads and the surrounding land.

6.2 General design

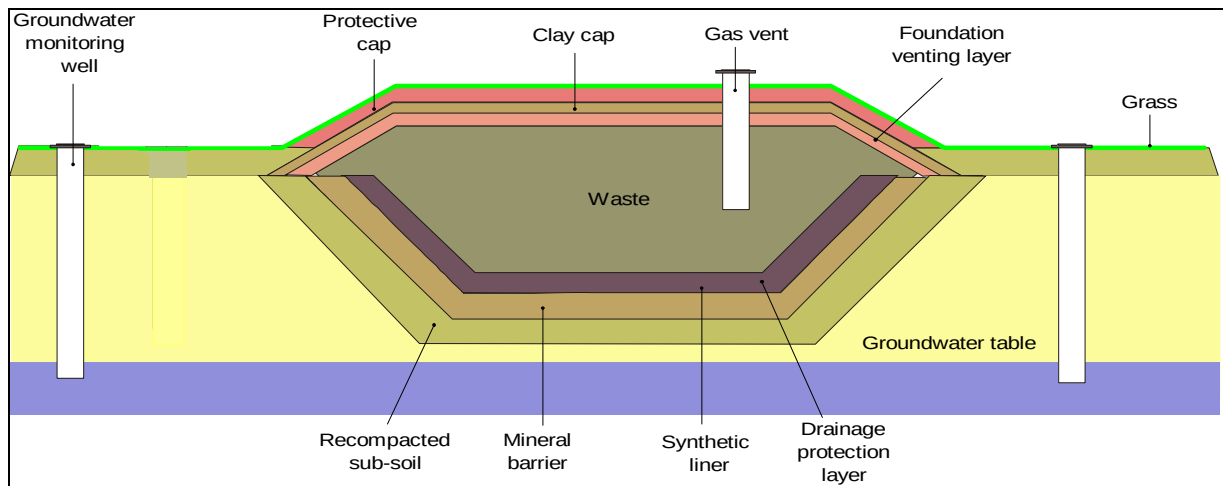


Figure 1 - Typical landfill

Based on the above typical design and depending of the environmental characteristics of the area, a specific design shall be required by Company.

Appropriate measures shall be taken, with respect to the characteristics of the landfill and the meteorological conditions, to:

- Control rainwater from entering into the core of the landfill
- Prevent surface water or groundwater from entering into the landfilled waste

- Collect contaminated water and leachate. If an assessment based on consideration of the location of the landfill and the waste to be accepted shows that the landfill poses no potential risk to the environment, Company may decide that this provision does not apply
- Treat contaminated water and leachate collected from the landfill
- Collect and dispose biogas when necessary.

In the case of a superficial aquifer, the landfill shall not be positioned below the water table. The structure shall be raised to avoid any contact between the water table and the bottom of the mineral barrier.

The final cover shall be the same regardless of climate or site sensitivity.

6.3 Design options

Design criteria are based on two main parameters: site sensitivity and rainfall intensity. Depending on these criteria, four different designs have been developed. Site sensitivity is determined by the criteria given in the table below, but may also be defined on a case by case basis by Company.

Table 1 - Site sensitivity criteria

1	Non-sensitive areas	Hydraulic conductivity less than 10^{-7} m/s Poor ecosystem Unconfined aquifer not close to the surface (depth > 3 m) No groundwater use by local population No population near the site area
2	Sensitive areas	Hydraulic conductivity greater than 10^{-7} m/s, layer thickness greater than 5 m Rich and fragile ecosystem Aquaculture or agriculture close to the selected site Unconfined aquifer near the surface (depth < 3 m) Groundwater used by local population Socio-economy turned to agriculture, aquaculture or fishing
I	Arid Climate	Rain water precipitation less than 200 mm/year
II	Temperate and humid climate	Rain water precipitation greater than 200 mm/year

The following tables summarize the minimum technical requirements for each criterion. The four general designs are illustrated by diagrams given in section 6.5. The detailed technical requirements are developed in the next section.