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Guidance on Practice for Plant Layout

GP 44-10

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GP 44-10. Guidance on Practice (GP) is based on parts of heritage documents from the merged BP companies as follows:

British Petroleum

RP 44-7 Plant Layout (February 1996).

Amoco

A BD-ELO-00-E Basic Design—Equipment Layout and Spacing—Design Specification (October 1997).

A BD-ELO-00-G Basic Design—Equipment Layout and Spacing—Guide (October 1997).

ARCO Oil and Gas

Design Guideline 5.5 Safety Design and Analysis – Equipment Spacing (May 1992).

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1. Scope

This GP provides guidance on all aspects of the layout of process plant, associated offsite facilities, and their equipment and structures within onshore installations. This GP is specifically applicable to conventional 'outdoor' installations for processing, storing, and handling flammable or toxic fluids. Examples include gas processing plants, refineries, chemical plants, marine loading/unloading facilities, and field sites; offshore facilities are excluded. This GP should be used for units constructed on site or modules fabricated offsite. This document is not retroactive, but as far as practicable, should be applied to expansions and modifications on existing sites as well as the installation of temporary facilities.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

BP

GP 04-10	Guidance on Practice for Drainage Systems.
GP 04-20	Guidance on Practice for Civil Engineering.
GP 04-30	Guidance on Practice for Design of Buildings Subject to Blast Loading.
GP 12-01	Guidance on Practice for Power System Design.
GP 14-01	Guidance on Practice for Noise Control.
GIS 14-011	Guidance on Industry Standard for Noise Control.
GP 22-10	Guidance on Practice for Design of Fired Heaters to ISO 13705 (API 560).
GP 22-20	Guidance on Practice for Design of Flares (API 537).
GIS 22-201	Guidance on Industry Standard for Flares (API 537).
GP 24-10	Guidance on Practice for Fire Protection – Onshore.
GP 24-03	Guidance on Practice for Inherently Safer Design Concept Selection.
GIS 24-233	Guidance on Industry Standard for Fire Water Pumps and System Design.
GP 26-10	Guidance on Practice for Heat Exchangers.
GP 30-55	Guidance on Practice for Control Rooms.
GP 30-85	Guidance on Practice for Fire and Gas Detection.
GP 34-00	Guidance on Practice for Machinery.
GP 42-10	Guidance on Practice for Design of Process Piping (ASME B31.3).
GP 44-30	Guidance on Practice for Event Modelling and Risk Based Evaluation.
GP 44-60	Guidance on Practice for API RP 500 Area Classification.
GP 44-65	Guidance on Practice for IP 15 Area Classification.
GP 44-70	Guidance on Practice for Overpressure Protection.
GP 44-80	Guidance on Practice for Relief Disposal Systems.
GP 76-01	Guidance on Practice for HSSE in Design and Loss Prevention.



American Institute of Chemical Engineers (AIChE)Center for Chemical Process Safety (CCPS), Guidelines for Facility Siting and Layout.**American Petroleum Institute (API)**

API RP 521	Guide for Pressure-Relieving and Depressuring Systems.
API RP 752	Management of Hazards Associated with Location of Process Plant Buildings.
API RP 2001	Fire Protection in Refineries.
API Pub 2218	Fireproofing Practices in Petroleum and Petrochemical Processing Plants.
API Std 2510	Design and Construction of LPG Installations.
API Std 2610	Design, Construction, Operation, Maintenance, and Inspection of Terminal & Tank Facilities.

British Standards Institute (BSI)

BS 4485	Water Cooling Towers.
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European Standard (EN)

EN 1473	Installation and Equipment for Liquefied Natural Gas - Design of Onshore Installations.
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Energy Institute (EI) – Formerly the Institute of Petroleum (IP)

IP 19	IP Model Code of Safe Practice – Part 19: Fire Precautions at Petroleum Refineries & Bulk Storage Installations.
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National Fire Protection Association (NFPA)

NFPA 30	Flammable and Combustible Liquids Code.
NFPA 58	Liquefied Petroleum Gas Code.
NFPA 59A	Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG).
NFPA 497	Recommended Practice on the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.

Process Industry Practices (PIP)

PNC00003	Process Unit and Offsites Layout Guide.
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3. Terms and definitions

For the purposes of this GP, the following terms and definitions apply:

Accessways

Paved areas for either vehicular or pedestrian access within plot limits.

Administration Area

That part of the site containing the main office buildings.

Battery Limit

The boundary of a process unit enclosing all equipment and unit limit block valves.



Complex

A group of units, the operation of which is interlinked, e.g. a group consisting of vacuum unit, catalytic cracker, alkylation unit, and sulphur recovery unit. On a small site, the term 'complex' may refer to all the process units on the site.

Depot

A storage area of capacity less than 5 000 tonnes (5 512 tons), with no processing facilities but with import and export facilities.

Equipment

The individual items, e.g. heat exchangers, that may make up a section.

Flammable Vapour

A general term to describe a flammable vapour or gas.

Ignition/Open Flame Area

An area containing equipment with open flame and, as practicable, surfaces hot enough to ignite flammable material in the process area.

In Plant Roads

Roads serving one or more units or sections (of units) within a plot.

Major Site Road

The main network of thoroughfare serving all plots within a site.

Minor Site Road

Other site roads serving one or more plots within the site.

Module

Any assembly of equipment items and their associated piping, instrumentation, electrical equipment, structure, and fittings, combined into a transportable subsection of a process unit or offsite facility. The definition includes all sizes and sources of assembly, including contractor or vendor pre-assembled units, preassembled or dressed complex equipment items, e.g. towers or fired heaters and pipe rack units.

Occupied Building

A building is considered to be occupied if any of the following criteria are met:

- A person(s) is (are) assigned to a location as a workstation or command and control center in case of an emergency.
- A person(s) is (are) assigned to a location designated as a safe haven in case of an emergency.
- A building is staffed 8 work-hours in a 24 hour period as part of an individual's primary job function.
- Cumulative occupancy is equal to or greater than 200 hours per week.

Offsites

The units and equipment that are not specifically part of the processing units, but which provide a service to the processing units. Offsites includes utilities (except within a process unit) and tankage.

Pipe Track

A grouping of unburied piping at or slightly below ground level.



Plant

A general term to describe any one or all the units on a given site.

Plot

An area of the site where a unit e.g. refinery CDU, chemical plant, or storage terminal is located.

Section

Part of a unit, e.g. the fractionation part of a catalytic cracker.

Service Areas

Workshops, stores, fire station, laboratory, or similar buildings.

Site

The land owned by BP or for which BP is responsible (i.e. the land within the perimeter fence).

Storage Terminal

A storage area with no processing facilities, but with import and export facilities. If the storage capacity is less than 5 000 tonnes (5 512 tons), this is classified as a depot.

Tank Compound

An area containing one or more tanks.

Unit

A main production component or plant in a refinery or chemical complex, e.g. a catalytic cracker or acrylonitrile plant. Note that 'unit' is the usual term in refineries whereas 'plant' is the usual term in chemical factories.

Utilities

Steam and power generation and transmission; condensate, process water, and cooling water treatment and supply; instrument and service air supply; effluent treatment and similar services.

4. Symbols and abbreviations

For the purpose of this GP, the following symbols and abbreviations apply:

BI	Business interruption
CSE	Concept Safety Evaluation
ISBL	Inside battery limit(s)
LNG	Liquefied natural gas.
LPG	Liquefied petroleum gas(es)
NGL	Natural gas liquid(s)
NPSH	Net positive suction head
OSBL	Outside battery limit(s)
PD	Property Damage
PSR	Project Security Review



QRA	Quantified risk assessment
SI	Système International d'Unités

5. General

5.1. Application of this GP

5.1.1. General

Layout is concerned with the spatial arrangement of the buildings and process equipment (and its interconnections) within the plant boundaries, the location of the plant area within the site boundaries, and the location of the site relative to the surrounding environment and residential communities. This GP makes a clear distinction between the layout of the various plants/units on a site and the arrangement of process vessels or equipment etc. within the plant (or plot).

5.1.2. Application to existing facilities

This document is not retroactive, but as far as practicable, should be applied to expansions and modifications on existing sites as well as the installation of temporary facilities.

5.1.3. Legislative regulations, local codes, and standards

- If there are local legislative regulations on layout for the country in which the site is located, these must be complied with other than where this GP is more rigorous than such statutory requirements.
- Minimum distance of equipment from site property lines shall comply with national (e.g. federal), state, and local codes and safety regulations or deed restrictions. If there is a conflict, the greater distance shall govern.
- If local codes and standards for plant layout conflict with guidance given in this GP, the more stringent text shall govern upon approval by BP.

5.2. Requirements

- Projects shall undergo a risk assessment to an appropriate level of detail as defined in GP 44-30.
 - Calculations relevant to layout or concerning potential major releases of hazardous materials shall be made available for such a review.
 - Less stringent exceptions to or variances from requirements specified in this GP shall be supported and documented by a risk assessment.
- New sites shall undergo a Project Security Review (PSR).
 - A PSR should be considered for expansions, revamps, and temporary facilities.
 - A regional security adviser can be located at:
<http://gbcweb.bpweb.bp.com/bpsecurity/Contacts/FindYourRSA.asp>
This review ensures that security risks such as terrorist activity and vandalism are reviewed and mitigated by competent personnel.
- Projects shall undergo a Concept Safety Evaluation (CSE) as described in GP 24-03. GP 24 03 shall be referenced for inherently safer design guidance.
- Environmental considerations shall be included in the plant layout design to ensure that projects and developments strive to achieve the corporate goal of “no damage” to the environment. Projects shall be in compliance with HSSE in design and loss prevention in accordance with the GP 76-01.



Damage can be caused by:

- *Emissions to the air, water, and ground.*
- *Physical interactions (nuisance, e.g. visual impact, noise, footprint, odour, dust, etc.).*
- *Energy inefficiency.*
- *Material use and waste generation.*
- *Interference with other users of the local environment.*

- e. Plant layout shall comply with noise control in accordance with GP 14-01 and GIS 14-011.

5.3. Philosophy

Plant layout is particularly important at the design stage because the potential for subsequent modification to the layout is very low. Plant layout is a major driver of the risk that must be managed throughout the lifetime of the facility.

Plant layout shall identify and adopt the safest cost effective layout that meets the requirements of the process design, safe operation/maintenance, and emergency action.

- a. Minimum spacing within plant shall be in accordance with:
 1. Clause 11 for aboveground storage tanks.
 2. NFPA 58 and API Std 2510 (or equivalent European standard) for LPG.
 3. EN 1473 or NFPA 59A for LNG.
 4. API 2001 for fire protection in refineries.
- b. Separation distances shall satisfy the following:
 1. Provide minimum access clearance for emergency response actions.
 2. Allow safe access for operation and emergency evacuation.
 3. Provide minimum access clearance for maintenance.
 4. Give an economic design.
- c. PIP PNC00003 offers separation distances for common items of equipment that satisfy the aforementioned criteria.
 1. These distances should be regarded as a maximum for economic layout purposes.
 2. Separation distance adjustments either way may be justifiable if a change could materially affect the hazard or risk or if unusual access or process reasons exist.
 3. Any proposal to increase these separation distances should be subject to a cost benefit analysis.
- d. Separation distances are flexible and should be judged on a hazard and risk based approach. Whilst a quantified risk based approach may be used for location of units, buildings etc. within a site, such an approach is, in general, considered impracticable as a basis for equipment layout within a unit.

Variations within practicable separation distances are likely to reduce the knock-on potential. However, risk reduction within a plot is, in general, more effectively achieved by measures such as inspection, maintenance, and protective systems (e.g. fire protection, shut down systems, drainage etc.).

5.4. Maintenance access

- a. Equipment shall be located with adequate access for mobile handling equipment during maintenance.

