



Document No.	GP 44-31
Applicability	Group
Date	3 December 2008

GP 44-31

Design and Location of Occupied Portable Buildings in Onshore Facilities

Group Practice

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

This is the first issue of GP 44-31. It is based on the former RM-GP 04-30-1 and revisions from this basis are identified by bars in the margin.

This Group Practice (GP) addresses the control of occupied portable buildings from explosion, fire, and toxic hazards. This GP sets criteria for building design to resist blast overpressure. Fire and toxic/flammable gas hazards are managed by a combination of separation distances and emergency response procedures.

Copyright © 2008 BP International Ltd. All rights reserved.

This document and any data or information generated from its use are classified, as a minimum, BP Internal. Distribution is intended for BP authorized recipients only. The information contained in this document is subject to the terms and conditions of the agreement or contract under which this document was supplied to the recipient's organization. None of the information contained in this document shall be disclosed outside the recipient's own organization, unless the terms of such agreement or contract expressly allow, or unless disclosure is required by law.

In the event of a conflict between this document and a relevant law or regulation, the relevant law or regulation shall be followed. If the document creates a higher obligation, it shall be followed as long as this also achieves full compliance with the law or regulation.



Table of Contents

	Page
Foreword	2
1. Scope	5
2. Normative references.....	6
3. Terms and definitions.....	6
4. Symbols and abbreviations.....	8
5. Location	8
6. Hazard scenarios and physical effect ranges.....	9
Zone definitions	10
7. and occupancy restrictions.....	10
7.1. Red zone	10
7.2. Yellow zone	11
7.3. Orange zone	11
7.4. Reduced hazard levels	11
8. Design	12
8.1. General.....	12
8.2. Buildings located outside of defined zones.....	12
8.3. Yellow zone	12
8.4. Orange zone	13
9. Control procedures	14
10. Emergency procedures.....	15
Annex A (Normative) Estimation of blast overpressure	16
A.1. Obstructed volume.....	16
A.2. Pressure contour	16
Annex B (Normative) Estimation of fire thermal radiation flux.....	19
Annex C (Informative) Zone boundary illustration.....	26
Annex D (Normative) TNO “Yellow Book Method” for determining obstructed volumes	27
Bibliography	28

List of Figures

Figure A.1 - Distance versus overpressure (Metric units)	17
Figure A.2 - Distance versus overpressure (customary units)	18
Figure B.1 - 9,5 kW/m ² thermal radiation flux contour (Metric units) (this graph includes an allowance of 0,8 kW/m ² for solar radiation)	20
Figure B.2 - 3 000 Btu/hr/ft ² thermal radiation flux contour (customary units) (this graph includes an allowance of 250 Btu/hr/ft ² for solar radiation)	21



Figure B.3 - 6,3 kW/m ² thermal radiation flux contour (Metric units) (this graph includes an allowance of 0,8 kW/m ² for solar radiation)	22
Figure B.4 - 2 000 Btu/hr/ft ² thermal radiation flux contour (customary units) (this graph includes an allowance of 250 Btu/hr/ft ² for solar radiation)	23
Figure B.5 - 1,6 kW/m ² thermal radiation flux contour (Metric units) (this graph includes an allowance of 0,8 kW/m ² for solar radiation)	24
Figure B.6 - 500 Btu/hr/ft ² thermal radiation flux contour (customary units) (this graph includes an allowance of 250 Btu/hr/ft ² for solar radiation)	25
Figure C.1 - Zone boundary illustration	26



1. Scope

- a. This GP provides requirements for design, location, and control procedures for existing as well as new onshore occupied portable buildings (as defined in 3) in refineries, petrochemical and chemical operations, natural gas liquids extraction plants, and bulk plants with an inventory of more than 4 500 kg (10 000 lb) of materials with a flash point below 38°C (100°F). In the U.S., this includes processes covered by the OSHA Process Safety Management Standard, 29 CFR 1910.119.

This includes gas processing/compression facilities in E&P and LNG facilities.

- b. For portable buildings which have remained on site beyond their defined period of use, the requirements of this GP are mandatory unless the portable buildings are compliant with GP 44-30.

- c. Only the occupied portion of a portable building need comply with this GP.

An example of this is an enclosed office in a temporary building used as a warehouse.

- d. This GP provides minimum requirements for inclusion in BP entity emergency procedures and control procedures.

- e. For the following facilities, the requirements of this GP are not mandatory but are recommended:

For these structures, the BP entity Leader should establish a process that manages risks associated with building location, occupancy, and evacuation.

1. Welfare facilities provided for personnel working outside in an area in which they are required to be located, such as:
 - a) Smoking huts with occupancy for less than 10 people.
 - b) Portable toilet facilities.
 - c) Covered rest/break shelters with lightweight fabric roofs, no side walls, and floor area not exceeding 37 m² (400 ft²).

Rest/break shelters should be spaced to avoid large congregations of employees in one plant area and contain only simple table and chairs secured to the ground to prevent movement.

There are, of course, other restrictions to locating these welfare facilities (compliance with electrical hazardous area classification, flare radiation exclusion zones, etc.).

2. Shelters in process areas provided solely to protect people and their work activities from adverse weather or to contain work area for safety reasons, such as the following:

Site management should ensure that none of these areas unintentionally becomes a gathering area for large numbers of people if the shelter is located in a restricted area.

- a) Enclosures for welding on in situ process equipment.
- b) Asbestos remediation enclosures.
- c) Personnel work site decontamination facilities required for safety purposes.
- d) Enclosures and associated control equipment for work, such as stress relieving or furnace pigging.



- e) Inert entry monitoring enclosures.
- f) Stack emission monitoring enclosures.
- g) Painting or sandblasting.
- h) Permit display shelters.

The function of a Permit Display Shelter is to physically display permits close to the job site and protect with a rain hood (e.g., a gazebo type shelter without walls).

- 3. Analyser shelters.

2. Normative references

The following referenced documents may, to the extent specified in subsequent clauses and normative annexes, be required for full compliance with this GP:

- For dated references, only the edition cited applies.
- For undated references, the latest edition of the referenced document (including any amendments) applies.

BP

GP 44-30	Design and Location of Occupied Permanent Buildings in Onshore Facilities.
GP 48-50	Major Accident Risk (MAR) Process.

American Society of Civil Engineers (ASCE)

Design of Blast Resistant Buildings in Petrochemical Facilities.

Process Industry Practices (PIP)

STC 010818	Structural Blast Resisting Building Design Criteria.
------------	--

3. Terms and definitions

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

Battery limit

Boundary of a processing unit enclosing all equipment and unit limit block valves or designated end of pipe runs if no block valves exist.

BP CIRBUS

BP suite of consequence modelling tools. Can be found at <http://sunapps.bpweb.bp.com/cirrus/>.

Bulk Plant

That portion of a property where flammable or combustible liquids are received by tank vessel, pipelines, tank cars, or tank vehicle, and are stored or blended in bulk for the purpose of distributing such liquids by tank vessel, pipeline, tank car, tank vehicle, or container. These plants store more than 4 500 kg (10 000 lb) in one location.

Entity (BP entity or Operating entity)

An organisational unit within BP which may be a Performance Unit, Business Unit, Strategic Performance Unit, Segments or some logical sub group of one of these, defined by the Segment, Function or Region.



ERPG

Emergency response planning guideline (ERPG) values are intended to provide estimates of concentration ranges where adverse effects might reasonably occur (as described in definitions for ERPG 2 and ERPG 3) as consequence of exposure to a specific substance. Emergency response planning committee of the American Industrial Hygiene Association sets ERPG values.

ERPG-2

ERPG 2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

ERPG-3

ERPG 3 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hr without experiencing or developing life threatening health effects.

Hazard

Condition or practice with the potential to cause harm to people, the environment, property, or BP's reputation.

Key personnel

Direct support personnel, such as operators, field supervisors, board operators, engineers, and maintenance personnel, that have to be located in immediate areas for logistical and response purposes.

Light hydrocarbon

Hydrocarbons with a NFPA flammability rating of 4 or 3. This covers all classes of hydrocarbons with a flash point below 38°C (100°F).

Occupied

Building is considered occupied if its primary purpose is to provide workspace or accommodation for personnel, irrespective of occupancy. Typical examples include office buildings, control rooms, laboratories, and gate houses.

If the primary purpose of a building is to house equipment (turbine enclosure, compressor shelters, motor control centre [MCC] rooms, analyser shelters, instrument outstation, process equipment enclosures in regions of severe weather, etc.), it is not considered occupied unless occupancy under normal operational conditions averages 2 man-hr or more per 24 hr period.

If building has distinct subbuildings with different primary purposes (e.g., an enclosed office within a storage building or an instrument room/MCC connected to a control room), occupancy of each part of the building may be considered separately.

Portable building

Building designed to be easily moved from location to location (e.g., trailers, portacabins, tents) that may be brought on site or constructed for defined period of use prior to removal (e.g., for discrete events, such as turnarounds and projects).

Risk

A measure of loss/harm to people, the environment, compliance status, Group reputation, assets or business performance in terms of the product of the probability of an event occurring and the magnitude of its impact. Throughout this Practice the term "risk" is used to describe health, safety, security, environmental, and operation (HSSE&O) undesired events.



4. Symbols and abbreviations

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

BLEVE	Boiling liquid expanding vapour explosion.
EA	Engineering authority.
ERPG	Emergency response planning guidance.
FLACS	FLame ACceleration Simulator.
IM	Integrity management.
LFL	Lower flammability limit.
LPG	Liquefied petroleum gas.
MOC	Management of change.
MCC	Motor control centre.
OMS	Operating management system.
PHAST	Process hazard analysis software tool.
SPA	Single point accountability.
VCE	Vapour cloud explosion.

5. Location

- a. Vulnerability of portable building occupants to major accidents (fires, explosions, and toxic releases) shall be reduced.

Vulnerability of building occupants is dependent upon building location with respect to process hazards, building type, and emergency procedures.

Hazardous effects of certain major accidents (blast overpressure and thermal radiation from fires and toxic effects) can develop and rapidly affect building occupants with little time for emergency response action. The approach presented in this GP is based on the onset of lethality for potential fire, explosion, and toxic events on process units.

- b. Options to eliminate need to house personnel in portable buildings shall be identified, evaluated, and documented thereby minimizing the use of occupied portable buildings.

An inherently safer approach is to locate portable buildings outside the zones defined in 1, even if this means they are located outside the site boundary.

Requirements for inherently safer design are provided in GP 48-04.

- c. Justification for occupied portable buildings located in the Yellow or Orange zones shall be formally documented. Evaluation shall include consideration of:

1. Rationale for why personnel need to be housed in a Yellow or Orange zone.
2. Removal of non key personnel during periods of increased risk (e.g., startup or shutdown of units whose hazards can affect portable buildings).



- d. Placement and corresponding design of an occupied portable building within the Yellow or Orange zone should be optimised within required placement area to present the lowest risk to building occupants.
- e. Proposed occupied portable buildings shall have documentation to demonstrate compliance with requirements for:
 - 1. Location.
 - 2. Building design.
 - 3. Emergency procedures.

6. Hazard scenarios and physical effect ranges

- a. Accident scenarios for aboveground equipment and associated distances to potentially harmful physical effects shall be determined using methodology in GP 48-50, Annex A.
Equipment located below ground is not included, but the associated piping and other connections located aboveground are included.
- b. Physical effect ranges from hypothetical events shall be calculated using the methods described in Annex A and Annex B or through modelling using BP CIRRUS. Alternate consequence modelling software including PHAST and FLACS may be used with approval by the entity EA.
PHAST and FLACS are proprietary software tools available from DNV and Gexcon, respectively. PHAST is a suite of various models. Consequence modelling expertise should be sought in selection of appropriate model for the appropriate model for the scenario being analysed.
- c. The following physical effect ranges shall be determined;
 - 1. VCE overpressure contours of 30 mbar (0,4 psig), 42 mbar (0,6 psig), and 200 mbar (2,9 psig).
 - 2. Thermal flux ranges
 - a) Thermal radiation flux ranges of 9,46 kW/m² (3 000 Btu/hr/ft²), 6,3 kW/m² (2 000 Btu/hr/ft²) and 1,6 kW/m² (500 Btu/hr/ft²).
 - b) Flare exclusion zone or radiant heat hazard distance from flares.
Methods for calculating flare radiation are provided in GP 44-80 or in BP CIRRUS.
 - c) If information in b) is not available for a flare, a distance of 100 m (330 ft) from the base of the flare shall be used for the flare exclusion zone.
 - d) Radiant heat contours shall be prepared based on scenarios involving rapidly developing fire scenarios.
This typically includes pool and jet fires on process units. BLEVE, atmospheric storage tank, and bund (dike) fires can be excluded from the assessment because these types of fires are typically slower developing, allowing opportunity for evacuation of personnel.
 - 3. Dispersion range to LFL for flammable clouds.
 - 4. Ranges to minimise all other risks, including ERPG-2 and ERPG-3, for toxic release scenarios.
- d. The following hazard ranges shall be identified:
 - 1. 150 m (500 ft) from any atmospheric blowdown stack used for light hydrocarbons.

