

APPENDIX 37

Guidance on Practice for Design and Location of Occupied Portable Buildings within Refineries and Chemical Plants



**Guidance on Practice for
Design and Location of Occupied Portable
Buildings within Refineries and Chemical
Plants**

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

This is the first issue of Site Technical Practice.

This GP is to address the control of people on BP facilities. The goal of this GP is that no person occupying a building within a BP facility shall come to any harm. BP believes that no one should unnecessarily be exposed to hazards. Having passed this hurdle, this GP will set out requirements around the design and location of occupied portable buildings.

This GP only addresses the design implications of overpressure and it is critical that all other hazards are fully understood by sites and managed through or covered by rigorous emergency response procedures.

Clarifications on applicability of this GP and on what constitutes compliance shall be given by the Engineering Authority (EA). Exemptions from requirements to this GP shall be subject to written approval by Segment EA and Segment Group Vice President, HSSE and Technology.

This GP applies to wholly owned and operated BP Refining and Chemicals facilities.

This GP applies to facilities that contain petrochemicals and hazards that are discussed in clause 6.

For application to Joint Ventures, the following shall apply:

- Where BP has operational control of a joint venture, BP shall, after an appropriate risk assessment, endeavour to adopt this GP and shall, if necessary, seek to amend relevant agreements immediately or upon renewal.
- Where BP does not have operational control of a joint venture, BP shall, after an appropriate risk assessment, endeavour to ensure the operator adopts this GP and shall seek to amend relevant agreements immediately or upon renewal to reflect this GP.
- Where it is not possible or feasible to require a joint venture to adopt this GP or, where a joint venture has agreed to adopt the GP, in the period before any Practice is adopted, BP shall seek to influence or persuade the joint venture to adopt guidance based on this GP.

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1. Scope

- a. This Guidance on Practice (GP) defines requirements for design and location of new and existing occupied portable buildings (as defined in clause 3), regardless of their duration on site, within refining and chemical sites.
- b. 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.
- c. This GP defines minimum requirements for inclusion in site emergency procedures and control procedures.
- d. For the following facilities, the requirements of this GP are not mandatory, but are highly recommended:
 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).

Note:

1. These 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.
 2. There are, of course, other restrictions to locating these facilities.
2. Shelters in process areas solely provided to protect people and their work activities from adverse weather or to contain work area for safety reasons, such as:
 - 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 stations that are designed for the potential blast overpressure in their location.

Note: Site management shall ensure none of these areas unintentionally become gathering areas for large numbers of people if they are located in restricted areas.

3. New and existing permanent fixed buildings. Such buildings are subject to requirements in GP 04-30.

4. Analyzer shelters.
- e. By excluding the structures in clause d. from this GP, sites shall establish a process that ensure risks associated with these structures are adequately managed, including control over location, occupancy, and evacuation.

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 04-30	Guidance on Practice for Design of Buildings Subject to Blast Loading.
GP 44-80	Guidance on Practice for Relief Disposal Systems.
GP 48-50	Guidance on Practice for Major Accident Risk Process.

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code (NEC).
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3. Terms and definitions

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

battery limit

The boundary of a processing unit enclosing all equipment and unit limit block valves or designated end of pipe runs where no block valves exist.

BP CIRRUS

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

ERPG-2

The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour 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

The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

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).

NFPA flammability ratings

- 4 Flash Point Below 23°C (73°F): This substance is very flammable, volatile or explosive depending on its state.
- 3 Flash Point Below 38°C (100°F): Flammable, volatile or explosive under almost all normal temperature conditions.

occupied

Occupancy for 2 man-hours or more in any 24 hour period.

portable building

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

This includes permanent buildings designed and built to be portable.

In some sites, portable buildings have been sited in one location for many years and have become a de facto permanent feature of the site.

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. The Emergency Response Planning Committee of the American Industrial Hygiene Association sets ERPG values.
IDLH	Immediate Danger to Life and Health.
LFL	Lower Flammability Limit.
MAR	Major Accident Risk.
MOC	Management of Change.
SPA	Single Point Accountability.
SPU	Strategic Performance Unit.
TAR	Turnaround.
VCE	Vapour Cloud Explosion.

5. Location

5.1. General

The vulnerability of portable building occupants to major accidents (fires, explosions, and toxic releases) shall be reduced.

The 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.

- a. Options to eliminate need to house personnel in portable buildings shall be identified, evaluated, and documented.
- b. Occupied portable buildings should be located outside the zones defined in clause 7, if possible, even if this means it is located outside the site boundary.
- c. Number of locations of occupied portable buildings shall be minimised.
- d. Justification for 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. The removal of all non key personnel during periods of increased risk, e.g., startup or shutdown of units whose hazards can affect portable buildings.
- e. The placement and corresponding design of an occupied portable building within the Yellow or Orange zone should be optimized within the required placement area to present the lowest risk to the building occupants.
- f. Proposed occupied portable buildings shall have documentation to demonstrate compliance with the requirements for:
 1. Location.
 2. Building design.
 3. Emergency procedures.

6. Hazard ranges

- a. Hazard scenarios shall be determined using methodology contained in GP 48-50, Appendix A. Requests for more precise methodology for estimating hazard scenarios shall be referred to BP Major Hazards and Fire Team.

Scenarios from site MAR study are a useful starting point.

- b. The effect ranges for the following scenarios shall be calculated using BP CIRRUS or other BP approved consequence modelling software:
 1. VCE overpressure contours of 30 mbar (0,4 psig), 50 mbar (0,7 psig), and 200 mbar (2,9 psig).
 2. Thermal ranges of 6,3 kW/m² (2 000 Btu/hr/ft²) and 1,6 kW/m² (500 Btu/hr/ft²).
 - a) Flare exclusion zone or radiant heat hazard distance from flares should be based on calculations from the flare vendor for the thermal radiation sterilization zone, as per GP 44-80, or flare radiation calculations using BP CIRRUS.
 - b) Where this information 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.

Radiant heat contours shall be prepared and based on scenarios involving rapidly developing and longer lasting fire scenarios. This typically includes pool and jet fires, but excludes flash fires, from which portable buildings can offer initial protection. BLEVE, tank and tank bund (dike) fires, except for pressurized storage

can be excluded from the assessment because these types of fires are slower developing and there is adequate capability for evacuation of personnel.

3. Dispersion range to LFL for flammable clouds.
 4. Ranges to minimize all other risks, including ERPG-2 and ERPG-3 for toxic release scenarios.
- c. The following Hazard ranges shall be identified:
1. 150 m (500 ft) from any atmospheric blowdown stack used for light hydrocarbons.
 2. 100 m (330 ft) from the base of any elevated main flare used for pressure relief disposal.
 3. Exclusion zones resulting from dispersion analysis as defined in GP 44-80 for other types of flares, including ground, off-gas, and biogas.
 4. Plant battery limits and tank bunded (diked) areas.
 5. Boundaries of electrical area classification [Zone 0/1/2 (Division 1/2)] hazardous area, where they exceed the plant battery limits or tank bunded (diked) areas.
- Electrical area classification is defined in GP 44-60 [2] and GP 44-65 [3].*
- d. Equivalent hazards from neighbouring locations shall be identified using best information available on nature and quantities of hazards.

7. Zone definitions

This GP recognizes that zone boundaries can change when hazard levels are significantly reduced, such as when the process unit has been shut down, deinventoried, and not impacted by hazards of other process units. Site MOC and permit to work processes shall flag and ensure that occupancy in portable buildings does not extend beyond of this limited period of reduced hazards. These zones shall be defined following a review of plot plans, physical walking of the site to understand variations and detailed consideration of any relevant operational considerations.

A zone boundary illustration is given in Annex C.

7.1. Red zone

The Red zone is a restricted area and occupied portable buildings must not be placed in the Red zone. The Red zone shall be determined as areas within any of the following:

- a. Areas of VCE overpressure contours of greater than 200 mbar (2,9 psig) as outlined in Annex A.
- b. Defined boundary of any thermal ranges of above 6,3 kW/m² (2 000 Btu/hr/ft²) as outlined in Annex B.

This assumes appropriate clothing is worn per API RP 521 [1].

- c. 100 m (330 ft) from equipment containing toxic material which could be released as toxic gas or vapour (ERPG-3 may be used if it is lower than 100 m (330 ft)).
- d. 100 m (330 ft) from live process equipment that presents a flash fire hazard (distance to LFL may be used if lower than 100 m (330 ft)).

Give consideration to other equipment that could give rise to a release of a flammable material (e.g. railcars, ships, barges).

- e. 15 m (50 ft) horizontal distance from live non-buried pipe tracks/ways/runs.
- f. 150 m (500 ft) from any atmospheric blowdown stack used for light hydrocarbons.

- g. 100 m (330 ft) from the base of any elevated main flare used for pressure relief disposal.
- h. Exclusion zones for other types of flares defined per dispersion analysis in GP 44-80.
- i. Plant battery limits.
- j. 30 m (100 ft) from tank banded (diked) areas containing a live tank.
- k. 100 m (330 ft) from a bund (dike) wall containing a tank with liquefied flammable or toxic gases.
- l. Hazardous area classification [Zone 0/1/2 (Division 1/2)].
- m. The Red zone boundaries may change depending on whether units are operating or shut down.

7.2. Yellow zone

- a. The boundaries of the Yellow zone shall not extend into the Red zone.
- b. The outside boundary of the Yellow zone is defined as the outermost distance of the following:
 - 1. VCE overpressure of 30 mbar (0,4 psig) as outlined in Annex A.
 - 2. Thermal radiation from all sources, including solar, of 1,6 kW/m² (500 Btu/hr/ft²) as outlined in Annex B.
 - 3. Toxic concentration of ERPG-2 for toxics.
 - 4. LFL for flammable clouds.
- c. No occupancy restrictions for portable buildings in the Yellow zone.
- d. The design of occupied portable buildings in the Yellow zone shall be per clause 8.1.b.
- e. The Yellow zone boundaries may change depending on whether units are operating or shut down.

It is recognized that for some sites, the boundary defined as the ERPG-2 concentration for toxics may extend well beyond the 30 mbar (0,4 psig), VCE overpressure contour. The creation of the Yellow zone allows for an occupied portable building that does not require special design considerations for VCE overpressure, except that mentioned in clause 8.1.b.1.

7.3. Orange zone

- a. The Orange zone is the area within the Yellow zone with a VCE overpressure between 50 mbar (0,7 psig) and 200 mbar (2,9 psig), as outlined in Annex A.
- b. Occupancy of portable buildings in the Orange zone shall be key personnel only.
- c. The design of occupied portable buildings in the Orange zone shall be per clause 8.1.c.
- d. The Orange zone boundaries may change depending on whether units are operating or shut down.

8. Design

8.1. General

- a. There are no design restrictions derived from this GP for occupied portable buildings located outside the zones defined in clause 7, and any activity is allowed. However, local building codes and regulations shall apply along with emergency response requirements.
- b. Occupied portable buildings in the Yellow zone shall:

1. Be fitted with glazing which will not injure occupants in the event of a 50 mbar (0,7 psig), such as, toughened glass, laminated glass, polycarbonate, float glass treated with anti-shatter film.
 2. Be single story, and nothing shall be installed on roof.
 3. Include foundations and/or anchoring to prevent building being overturned by wind or explosion overpressure.
 4. Be provided with emergency equipment, including alarms, signage, and firefighting facilities.
 5. Have direct vision of a windsock from the exit doors of the building.
 6. Be provided with emergency egress doors that open outwards and are clearly designated.
 7. Be provided with skirts that prevent build-up of gas concentrations underneath.
 8. If within range of flammable gas dispersion or ERPG-2 for toxics, be provided with tightly shutting windows and doors with adequate seals to prevent rapid build up of gas within the building.
 9. If placed within an area of possible toxic gas exposure, then there shall be an adequate means for warning in order to allow for safe evacuation. Alternatively, shelter in place/toxic refuge capability with gas detection on the air intake and automatic shut-off of the air intake should be assessed for providing the highest level of protection which does not require notification/intervention from Operations.
 10. Be located in such a way to avoid confinement with other buildings or equipment.
- c. In addition to the requirements in clause 8.1.b, occupied portable buildings in the Orange zone shall:
1. Be designed and verified to withstand a VCE overpressure of 200 mbar (2,9 psig). No modifications shall be made to a building once it is verified for the proper overpressure.
 2. Contain no windows unless certified safety glass, for example, fully tempered or laminated. If not, windows shall be either removed or boarded on the inside.
 3. Have walls that are verified/designed to resist reflected overpressure and a roof designed to resist free-field overpressure. Reference GP 04-30.
 4. Have doors that are upgraded to ensure they do not fail injuring occupants and are operable after event.
 5. Have the furniture and interior fittings secured to prevent them from falling or being thrown onto occupants by overpressure force of any explosion.
- Additional guidance can be found GN 04-001 [4].*
- d. Occupants of portable buildings within ERPG-2 shall be provided with suitable equipment and training to ensure safe escape.

8.2. Toxics/hydrocarbon vapour clouds

- a. An attempt should be made to locate occupied portable buildings outside the range of LFL from flammable gas release scenarios and ERPG-3 for toxic release scenarios. For buildings within these ranges, the following options shall be used to ensure low occupant vulnerability:
 1. Design building as shelter in place/toxic refuge for applicable flammable/toxic scenario.

2. Provide a specific emergency response procedure designed to evacuate personnel to a safe location.
Evacuation through a toxic cloud is possible if the occupants have appropriate escape equipment and training. Evacuation through a flammable cloud should not be part of the emergency response plan.
 3. If the requirements of 1. and 2. above cannot be met, then an occupied portable building shall not be placed the location.
- b. If evacuation of occupied portable building is required under site emergency plan, it shall be confirmed that adequate warning can be given to allow safe evacuation to take place.

8.3. Overpressure Considerations

Contours for overpressure should consider effects of vapor cloud explosion and equipment catastrophic failure. Overpressure effects of BLEVEs can be excluded if there is sufficient time to evacuate personnel during the time it takes a BLEVE to develop. Assessments should be performed for processes containing flammable gases and liquids. Processes containing only combustible materials can be excluded from vapor cloud explosion calculations due to low potential for a vapor cloud explosion.

9. Control procedures

Sites shall develop and maintain procedures for control of occupied portable buildings. Procedures shall include:

- a. Reference to applicable legislation and this GP.
- b. Requirement that occupied portable buildings be subject to MOC approval process that includes a holistic hazard analysis. Approval process shall include risk assessment that, as a minimum, takes the following into account:
 1. Hazards from possible fires, explosions, flammable hydrocarbon, and toxic releases.
 2. Potential occupied portable building impact threats, e.g., equipment falling from crane lifts, vehicles, or missile damage from process plant incident (including from offsite location).
 3. Potential personnel impact threats from furniture and fittings.
 4. Environmental risks, e.g., hurricanes, ground condition, and proximity to flood areas.
 5. Emergency procedures, including raising alarm and evacuation.
 6. Maximum allowable occupancy.
- c. Requirement that the following information is available prior to and serves as information for any hazard review:
 1. Plot plan showing the placement of the building, locations of blowdown and flare stacks, atmospheric relief discharges, prescribed consequence contours listed above, locations of fire protection and detection systems.
 2. Design specifications for the portable building, including explosion rating, ventilation systems design, detection and alarm systems.
 3. Proposed layout of the building and orientation.
 4. Proposed occupancy levels including normal and peak occupancy.
 5. Draft of emergency response plan.

- d. The siting of occupied buildings in a Yellow or Orange zone shall be approved by the site's most senior site manager and should have the concurrence of the site EA. Approval requirements for occupied portable buildings in areas outside the zones defined in clause 7 are according to site delegation of authority.
- e. A detailed list of job types that are considered key personnel that are occupants of portable buildings in the Orange zone.
- f. Procedures to identify SPA and associated responsibilities for the following:
 - 1. SPA for maintaining a controlled copy of a site plot plan identifying hazard contours and identified Yellow, Orange, and Red zones and to ensure it is updated if changes occur.
 - 2. The site IM SPA shall be responsible for ensuring that this policy is followed and occupied portable buildings are appropriately designed and placed to protect occupants from explosion, fire, and toxic gas hazards. The site IM SPA is responsible for maintaining a register of occupied portable buildings and associated documentation produced as a result of this policy.
 - 3. An SPA for each occupied portable building, who is responsible for ongoing safety of occupants, including making sure that occupants are practiced on the building's emergency procedures.
- g. A signed permit approving the location, design, and occupancy of all portable buildings be prominently displayed.
- h. Retention of all relevant documentation for the life of the building at the site.

10. Emergency procedures

Each site shall have a procedure for evacuation of occupants from portable buildings when facilities that can affect safety of occupants are started up, shut down, or during upset conditions.

For major accidents whose hazardous effects develop less rapidly, such as BLEVE toxic/flammable gas dispersion, the time to allow for emergency response shall be considered.

For these events a combination of separation distance, building design, and emergency response are used to ensure low vulnerability.

- a. Occupied portable buildings shall be included in site Emergency Response Plan.
- b. Effective emergency response procedures shall be in place for occupied portable buildings.
- c. Procedures shall be communicated to occupants via signage and briefings.
- d. Effectiveness of procedures shall be tested in exercises within 1 week of initial occupancy.
- e. The following shall be considered in developing emergency procedures:
 - 1. Raising alarm, distinguishing between when to evacuate and when to remain in occupied portable building.
 - 2. Means of escape routes and, potentially, provision of escape equipment. Personnel shall be trained in use of any escape equipment.
 - 3. Location of evacuation safe locations, whether shelter in place/toxic refuge buildings or outside evacuation/muster points.

Annex A (Normative) Estimation of Blast Overpressure

The overpressure developed by an explosion within a process area is related to the obstructed volume. In a free field, a flammable vapour will burn at its laminar burning velocity. If obstacles are placed within the flammable vapour, the turbulence induced as the flame passes over the obstacles creates turbulence, which increases the flame speed. The increased flame speed causes increased turbulence. This self reinforcing mechanism leads to rapid increase in combustion and a build-up of overpressure, as combustion products cannot escape from the combustion area sufficiently rapidly. The magnitude of the overpressure developed is related to the density of the obstructions and the size of the obstructed volume.

A.1. Obstructed Volume

Obstructions within the obstructed region must be sufficiently close to one another to maintain the turbulence-combustion feedback.

- a. As a first approximation, the obstructed volume may be taken as the area of the process plant multiplied by the maximum height of equipment in the process plant.

The height dimension for the obstructed volume will typically include equipment and piping on the top floor of the main structure, but will not extend to include discrete high points, e.g., the top of a distillation tower.

- b. Where a more precise approximation is required, the obstructed region may be estimated using the TNO “Yellow Book Method” described in Annex D.

This method eliminates void space which will not contribute to the turbulence inducing feedback, identifies where areas within the plant should be considered as separate obstructed regions, and allows the energy involved in the explosion (the volume of the gas which can burn in the obstructed region) to be reduced by subtracting the volume occupied by the obstacles themselves from the volume of the obstructed region. The detail of this method is reproduced overleaf.

A.2. Pressure Contour

When the plant obstructed volume has been estimated, the graph shown in Figure A.1 shall be used to predict the distance to the 200 mbar, 50 mbar and 30 mbar contours.

Figure A.1A – Distance versus overpressure (SI)

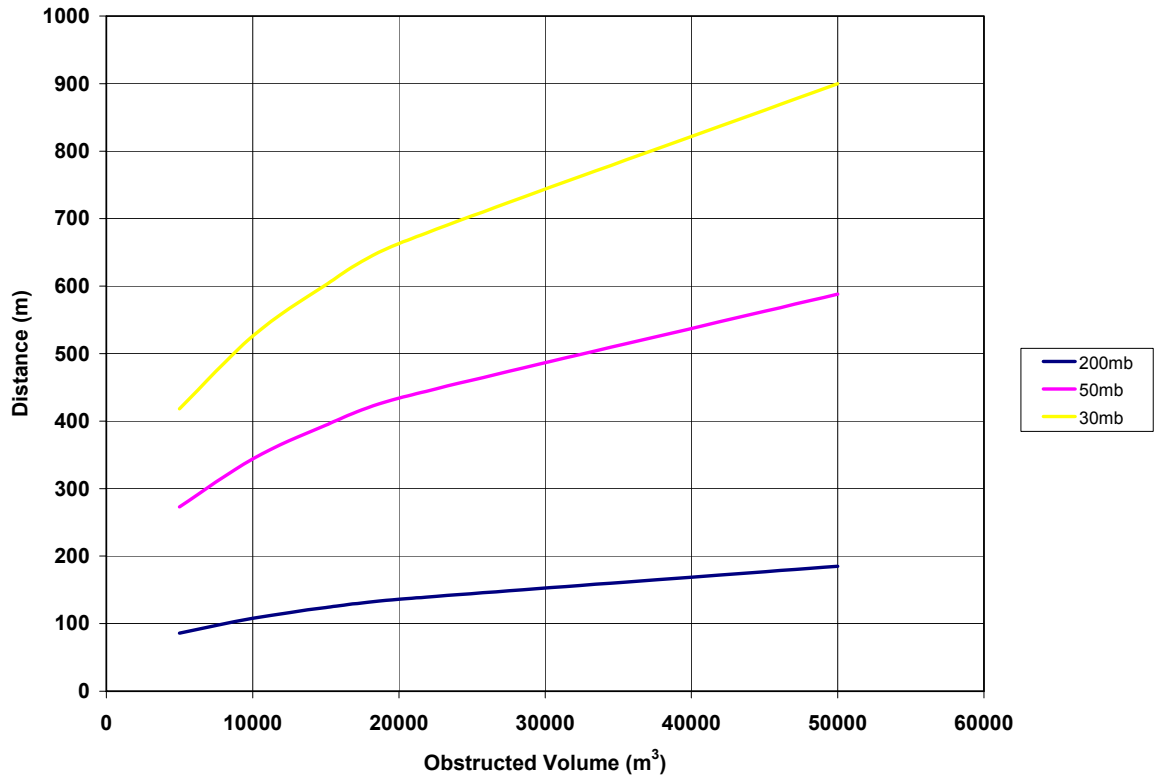
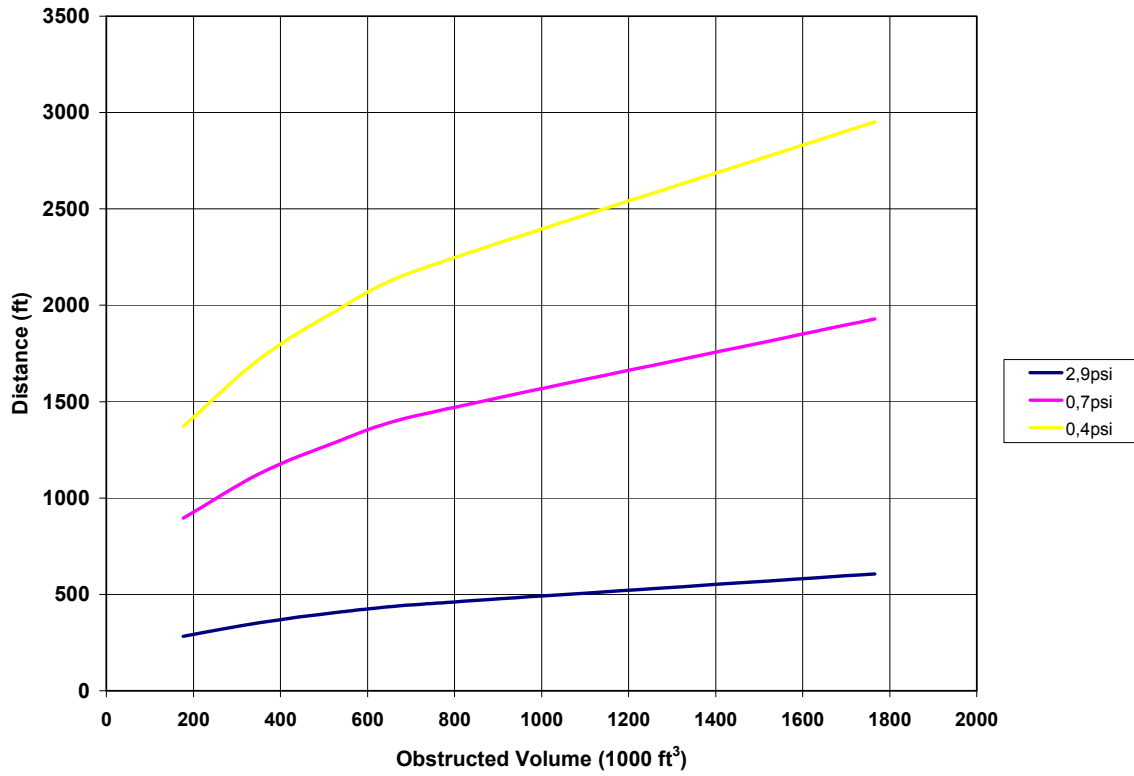


Figure A.1B – Distance versus overpressure (English)



Annex B (Normative) Estimation of Fire Thermal Radiation

The thermal radiation from a fire at a specified distance from the fire is dependent on three primary factors:

- *The mass of flammable material which is burning.*
- *The type of flammable material which is burning.*
- *The distance of the specified location from the surface of the fire.*

The first two considerations determine the shape and effective surface emissive power of the flame. The third consideration determines the degree of atmospheric attenuation and the view-factor of the flame at the specified location.

As a fire diameter increases two competing phenomena occur. The path length within the flame available to generate thermal radiation increases, and the path length within the flame available to absorb radiation increases. These are not linear relationships. Development and absorption by soot particles is particularly significant.

In Figures B.1 and B.2 the distance to a thermal radiation level of 6,3 kW/m² (2 000 Btu/hr/ft²) and 1,6 kW/m² (500 Btu/hr/ft²) is plotted as a function of fire diameter for the types of fire which might occur in hydrocarbon processing and storage areas. This calculation assumes a background radiation level of 0,8 kW/m² (250 Btu/hr/ft²) which is equivalent to bright sunshine.

- a. For a process area or other facility, the area of the maximum fire at ground level for the type of material should be estimated, taking into account topography and drainage.
 1. For hydrocarbons with a molecular weight of less than 60, the LPG relationship should be used.
 2. For other hydrocarbons, the crude oil relationship should be used.
- b. When the facility maximum fire area has been estimated, the graphs shown in Figure B.1 and Figure B.2 shall be used to predict the distance to the 6,3 kW/m² (2 000 Btu/hr/ft²) and 1,6 kW/m² (500 Btu/hr/ft²) thermal radiation contours.

Figure B.1A – 6,3 kW/m² thermal radiation contour (SI)

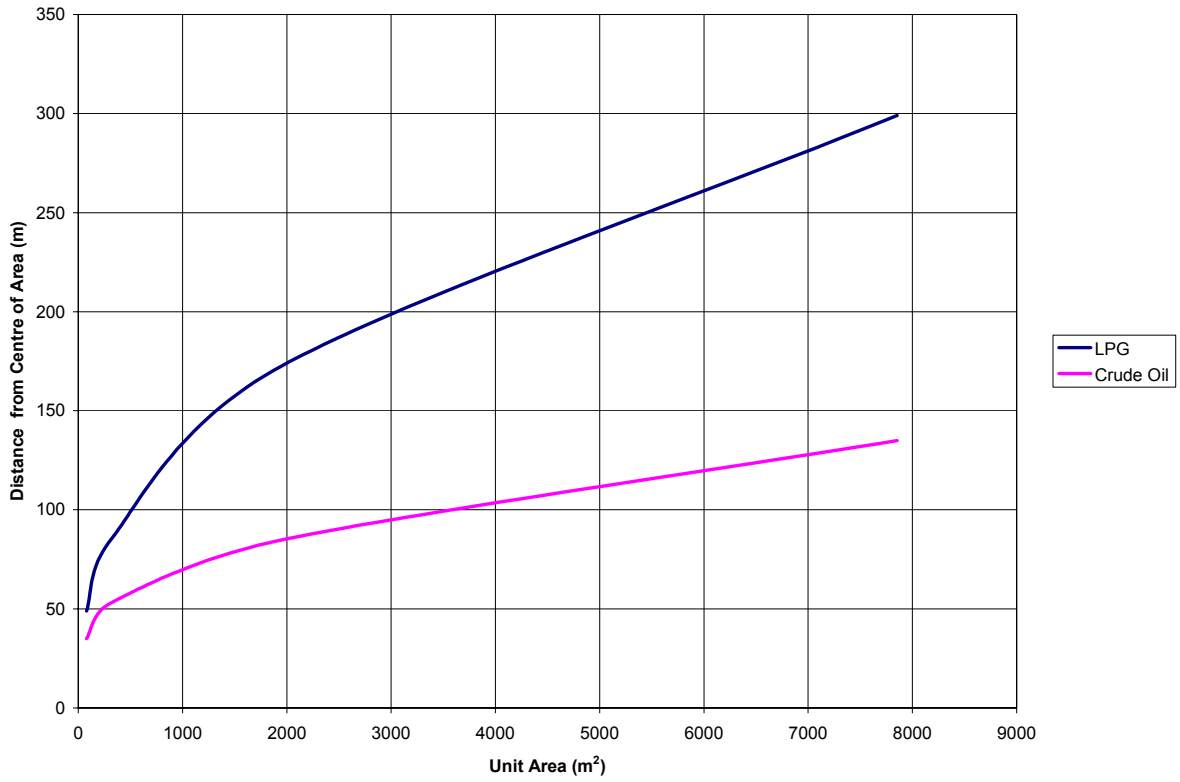


Figure B.1B – 2 000 Btu/hr/ft² thermal radiation contour (English)

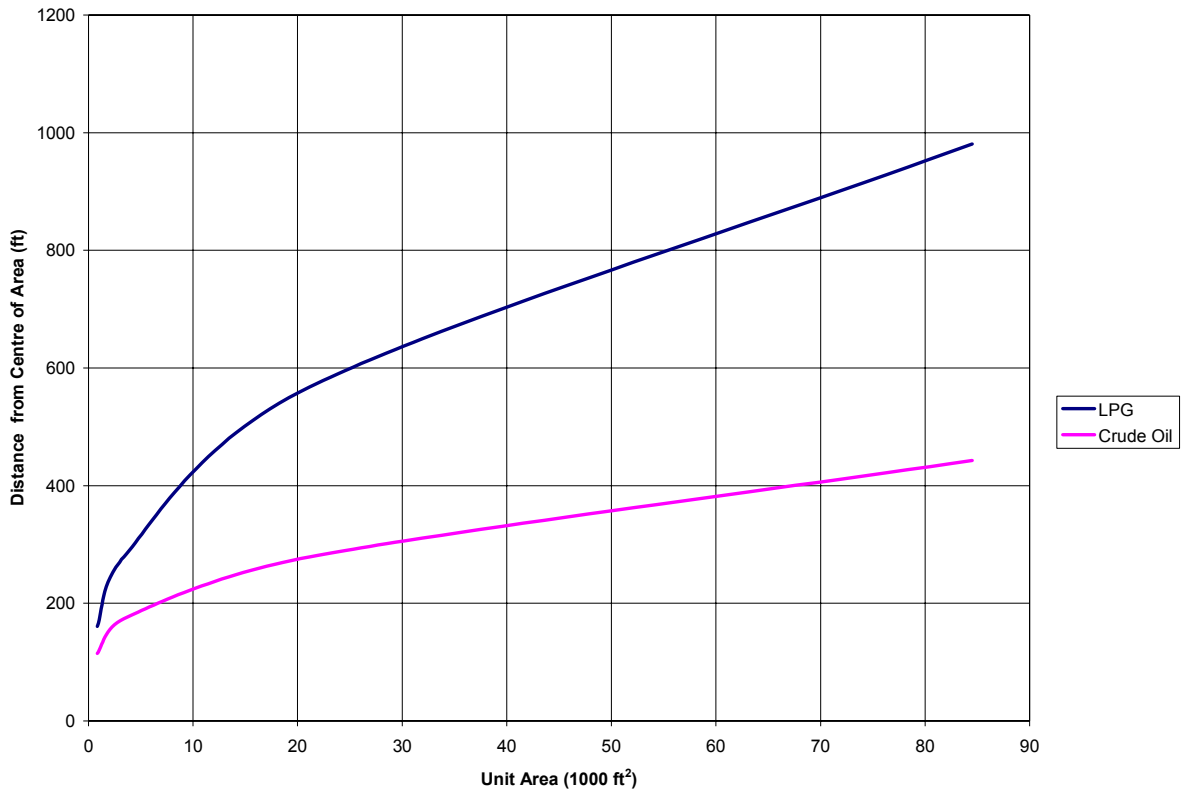


Figure B.2A – 1,6 kW/m² thermal radiation contour (SI)

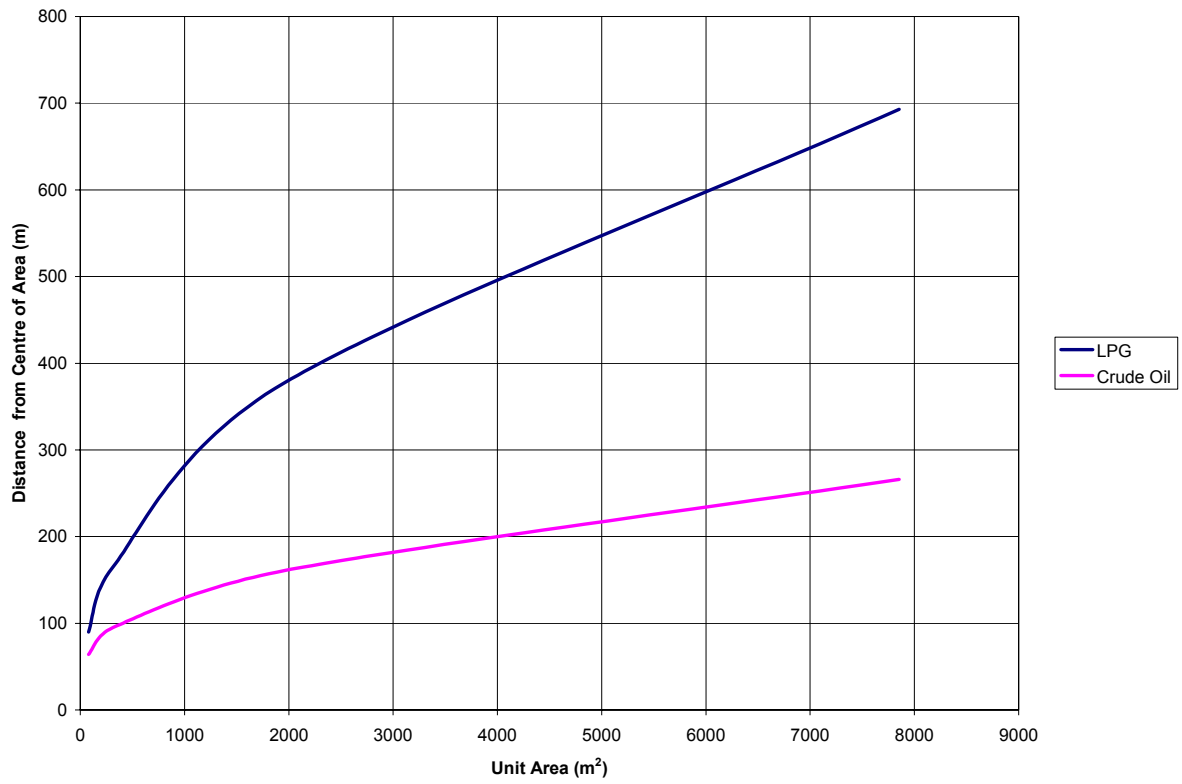
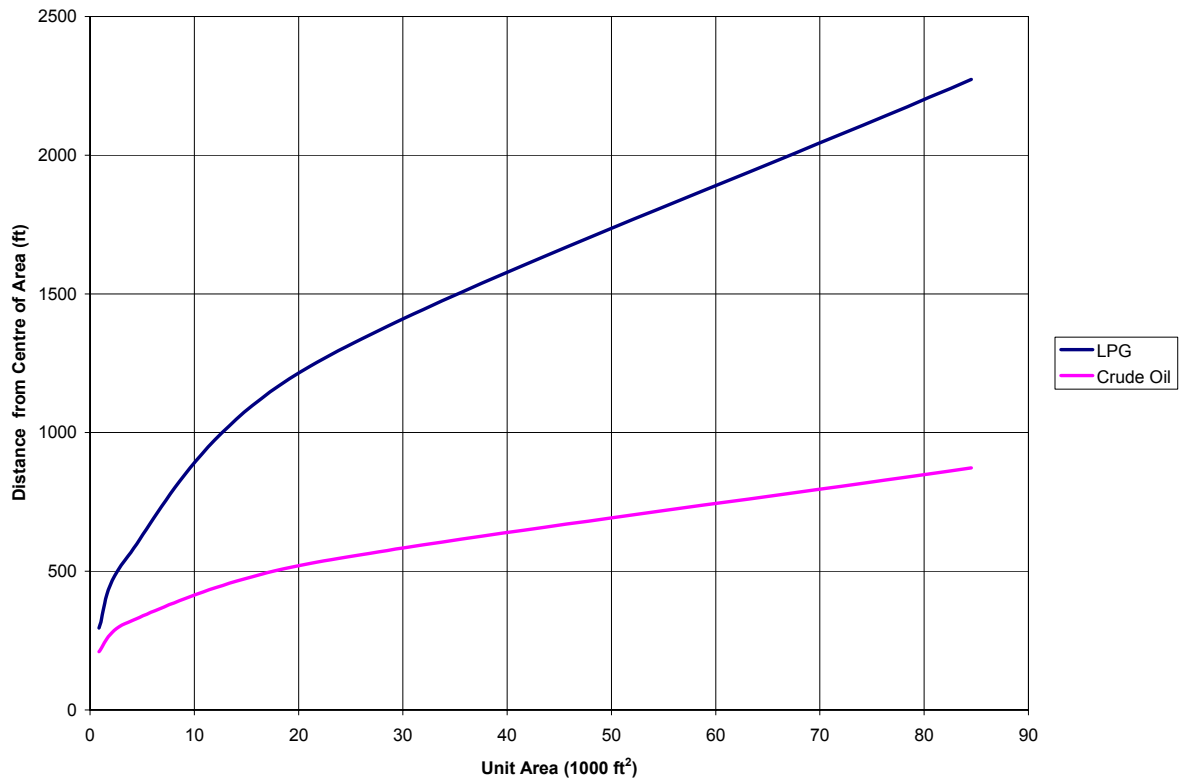
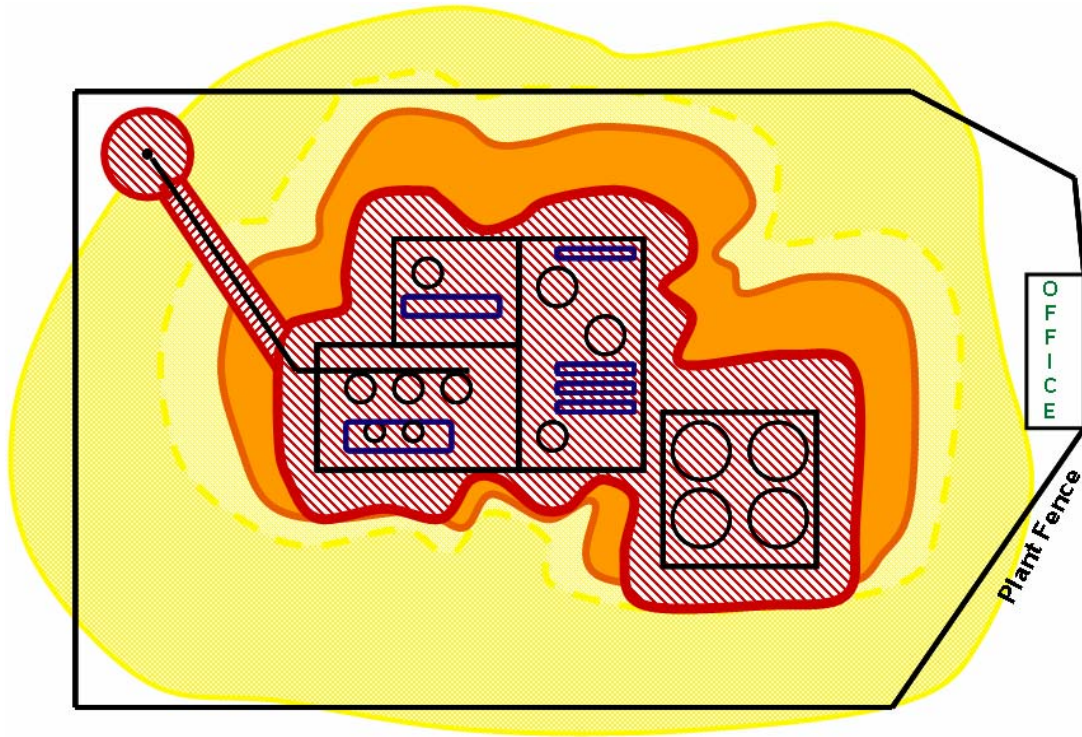


Figure B.2B – 500 Btu/hr/ft² thermal radiation contour (English)



Annex C
(Informative)
Zone Boundary Illustration

Figure C.1 – Zone boundary illustration



Annex D
(Normative)
TNO “Yellow Book Method” for Determining Obstructed Volumes

Refer to the following publications for determining obstructed volumes:

1. Application of Correlations to Quantify the Source Strength of Vapour Cloud Explosions in Realistic Situations. Final report for the project ‘GAMES’, PML 1998-C53, W.P.M. Mercx, A.C. van den Berg, D. van Leeuwen, TNO Prins Maurits Laboratory, 1998.
2. Methods for the Calculation of the Physical Effects Due to Releases of Hazardous Materials, Committee for the Prevention of Disasters (TNO Yellow Book), CPR-14E, The Hague, The Netherlands, 1997.

Bibliography

American Petroleum Institute (API)

- [1] API RP 521 Guide for Pressure-Relieving and Depressuring Systems.

BP

- [2] GP 44-60 Guidance on Practice for API RP 500 Area Classification.
- [3] GP 44-65 Guidance on Practice for IP 15 Area Classification.
- [4] GN 04-001 Part 1 – WBE Project No. A100-301 – Upgrades to Mitigate Hazards from Non-Structural Components in Blast Loaded Buildings.