

CGA P-64—2014

**GUIDELINE FOR THE LOCATION
OF OCCUPIED BUILDINGS IN
INDUSTRIAL GAS PLANTS**

FIRST EDITION

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1 Introduction

Incidents have shown the need for the chemical industry to consider the location of both permanent and portable occupied buildings on chemical production facility sites. The ignition of flammable vapor released into a congested process area or pressure energy released from process equipment failures can impact personnel located inside these buildings. Industry groups such as the American Petroleum Institute (API), the Center for Chemical Process Safety (CCPS), and the Chemical Industry Association (CIA) have developed guides to assist these industry companies in the safe location and design of occupied buildings to improve the safety of workers. In some regions, assessing the risk to occupants in buildings within air separation unit (ASU) facilities is not specifically required by regulations.

This publication is intended to provide guidance specific to the industrial gas industry for the determination of location and design of both permanent and portable on-site occupied buildings to address the risks in ASU and HYCO plants.

The goal of this publication is to provide guidelines to:

- protect the building occupants so the building does not place the occupants at greater risk than employees located outside; and
- reduce the risk to employees not essential to the operation of the facility by locating such employees in a building that is either:
 - away from the process; or
 - reinforced and/or equipped to achieve comparable risk reduction to that achieved by distance alone.

Risk management and process safety assessment are complex subjects. Technology for determining the location of occupied facility buildings is still evolving. Some aspects of this technology require the application of technical judgement as well as proven scientific methodologies. It is the intention that this publication be used by qualified personnel. Qualified personnel are those who have sufficient training and experience in hazard identification and risk assessment.

While this publication is intended to provide an overview of the processes and evaluations used to determine safe location of occupied buildings, it is not intended to be a strict, prescriptive requirement. As individual company processes, risk targets, facility layouts, and safety procedures vary, each facility should be evaluated individually to ensure safe location of occupied buildings.

2 Scope

This publication addresses the risks to persons in occupied buildings within ASU and HYCO facility boundaries associated with pressure energy. Pressure energy can be generated from ignition of flammable material that has been released into congested or confined area and the sudden failure of pressure vessels. Section 6.4 provides criteria for the exclusion of specific pressure vessel mechanical failures from consideration.

This publication is intended to provide guidance on determining the risk to persons in:

- new permanent or portable occupied buildings on ASU and HYCO facilities;
- existing occupied buildings from a new ASU plant, HYCO plant, or major modification added to an existing facility;
- an occupied building from a relocated ASU plant, HYCO plant; and
- a relocated occupied building.

It is also intended to provide guidance on how to address hazards from neighboring facilities during the design of new ASU and HYCO plants. The provisions of this publication are effective as soon as hazardous materials are introduced into the ASU or HYCO facility.

The scope of this publication is not intended to cover the following:

- Existing buildings in existing ASU and HYCO plants;
- Occupied buildings beyond the ASU or HYCO facility boundary, as this publication is specific to on-site impacts within ASU and HYCO facilities. CCPS *Guidelines for Facility Siting and Layout*, the Seveso III Directive, and other sources provide general guidance on this topic [1, 2]¹;
- The location and design of occupied buildings as related to exposures from toxic gas releases. [API RP 752](#), *Management of Hazards Associated with Location of Process Plant Buildings*, [API RP 753](#), *Management of Hazards Associated with Location of Process Plant Portable Buildings*, and the CIA document *Guidance for the Location and Design of Occupied Buildings on Chemical Manufacturing Sites* provide guidance on mitigation of hazards related to a toxic release [3, 4, 5];
- The location of oxygen and inert gas vents relative to the location of buildings. EIGA Doc 154, *Safe Location of Oxygen and Inert Gas Vents* provides guidance on the safe location of oxygen and inert gas vents [6]; and
- Cryogenic spills from air separation facility equipment. Many CGA and EIGA publications provide guidance on control of cryogenic spill hazards; see Section 10 for additional references.

For industrial gas facilities not included in the scope of this standard, see NFPA 55, *Compressed Gases and Cryogenic Fluids Code* or other equivalent regional standards for siting considerations [7].

3 Definitions

For the purpose of this publication, the following definitions apply.

3.1 Publication terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

3.1.3 May

Indicates that the procedure is optional.

3.1.4 Can

Indicates a possibility or ability.

3.2 Technical definitions

3.2.1 Blast

Transient change in the gas density, pressure, and velocity of the air surrounding an energy release point.

3.2.2 Building

Any permanent or portable structure that is enclosed on all sides with a roof.

3.2.3 Building siting study

Procedures to evaluate the hazards and establish the design criteria for new buildings.

3.2.4 Confinement

Physical surface that inhibits the expansion of a flame front of burning vapor in at least one direction. Examples include solid decks, walls, enclosures, or process areas.

¹ References are shown by bracketed numbers and are listed in order of appearance in the reference section.

3.2.5 Congestion

Collection of closely spaced objects in the path of the flame front that has the potential to increase flame speed to an extent that it can generate a damaging blast wave.

3.2.6 Consequence

Potential effects due to overpressure resulting from ignition of flammable gas in a congested area, failure of a pressure vessel, or process upsets. Descriptions may be qualitative or quantitative.

3.2.7 Consequence-based methodology

Methodology used for building siting study that is based on consideration of the impact of a blast wave that does not consider the frequency of events.

3.2.8 Energy release

Sudden discharge of chemical or stored energy due to chemical reaction such as combustion of a fuel in air or failure of a pressurized vessel.

3.2.9 Flammable mixture

Mixture of a flammable gas and an oxidant that is within the flammable range.

3.2.10 Impulse

Measure that can be used to define the ability of a blast wave to do damage. It is calculated by the integration of the pressure-time curve.

NOTE—This term is expressed in units of pressure-time.

3.2.11 Individual occupancy

Total number of hours per year spent by an employee in a building.

3.2.12 Light wood trailer

Portable building with a wall design consisting of “2 x 4” studs/wall members (nominal 1.5 in x 3.5 in) with a thin outer skin.

NOTE—This is generally representative of the weakest portable building used by the chemical process industry.

3.2.13 Maximum individual occupancy

Number of hours per year spent by the most present employee in a building.

3.2.14 New facilities

Facilities built, designed, or relocated after April 1, 2014.

3.2.15 Occupied building

Portable or permanent building where personnel are assigned to perform work on a routine basis or which is used for a recurring group personnel function.

3.2.16 Occupant vulnerability

Proportion of building occupants that could potentially suffer a permanent disability or fatality if an energy release were to occur.

3.2.17 Overpressure

Any pressure above atmospheric caused by a blast.

3.2.18 Portable building

Any building that can be easily moved to another location within the facility, regardless of the length of time it is kept at the site.

3.2.19 Pressure vessel

Vessel that operates at or above 15 psi (1.03 bar).

3.2.20 Pressure volume (PV) energy

Sudden expansion of a compressed gas or flashing liquid generating a blast wave that propagates outward from the source.

3.2.21 Process area

Assembly of equipment consisting of but not limited to pressure vessels, heat exchangers, distillation equipment, compressors, storage containers, vaporizers, manifolds, and piping that terminates at the point where the gas supply first exits the ASU or HYCO unit boundary.

3.2.22 Quantitative risk assessment (QRA)

Numerical estimates of expected frequency and consequence of potential events based on engineering evaluation and mathematical technique. The numerical estimates can vary from simple values of probability/frequency of an event occurring based on relevant historical industry to more complex methods of frequency determination.

3.2.23 Reflected pressure

Impulse or pressure experienced by an object facing a blast.

3.2.24 Side-on pressure

Impulse or pressure experienced by an object as a blast wave passes by it.

3.2.25 Risk-based analysis

Quantitative risk assessment used for building siting study that takes into consideration numerical values for both the consequences and frequencies of vapor cloud explosions, pressure vessel structural failures, or other serious failures resulting in energy releases.

3.2.26 Vapor cloud explosion (VCE)

Energy release (deflagration or detonation) resulting from ignition of a cloud of flammable vapor, gas, or mist in which flame speeds accelerate to sufficiently high velocities to produce overpressures.

4 Building siting study methodologies

4.1 General information

The three methodologies presented in this publication to perform a building siting study are a simplified approach, consequence based, and risk based. The simplified approach is only applicable to locating portable buildings that can be exposed to flammable vapor cloud release risks. Individual companies may use any or a combination of these analysis methods to determine safe locations for occupied buildings at ASU and HYCO plants. Sections 5 and 6 describe information that is necessary for each method.

Where local codes or standards (such as fire codes or building codes) require buildings to be located at greater distances than the distances resulting from the methods described in this guideline, the greater distances should be followed.

In addition to the approaches described in this guideline, there are several other accepted approaches to the calculation of overpressure that can be used in addition to or in place of the methodology presented. *CCPS Guidelines for Vapor Cloud Explosion, Pressure Vessel Burst, BLEVE, and Flash Fire Hazards*, provides extensive guidance on the calculation of overpressure [8]. Examples of commercially available software to calculate overpressure include PHAST™, PHAST Risk™, and SafeSite_{3G}® [9, 10, 11].

4.2 Introduction to consequence-based analysis

The consequence-based methodology evaluates the potential impact of sudden energy releases on nearby buildings without considering the probability of the energy release occurring. Some variations of the method may consider impulse as well. A consequence-based methodology determines whether a new building can be located or designed to withstand the overpressure level to which it may be exposed. Guidance regarding which buildings and scenarios should be included or excluded in the analysis is shown in Sections 5 and 6.

4.3 Introduction to risk-based analysis

The risk-based analysis not only considers the information from a consequence-based analysis, but also considers the frequency and probability of hazardous exposures to the building and occupants.

A tolerable risk level shall be defined before performing the analysis.

4.4 Introduction to overpressure concepts

Overpressure radiates from the source of a blast such as a vapor cloud explosion (VCE) or pressure volume (PV) burst but decays rapidly with distance from the source and with time. Figure 1, from Baker Engineering and Risk Consultants, Inc., provides a pressure wave illustration [12].

A secondary effect of the overpressure wave is the drag loading, which is equivalent to a very high velocity wind. It propels the debris generated by the air-blast, creating secondary projectiles. Also, the building is subject to a ground-shock, which produces ground motions similar to a short duration earthquake. The ground shock effect is generally not considered during this building siting analysis.

As the overpressure wave expands and diffracts (wraps or bends) around a building, it exerts an overpressure on the front wall, on the roof, sidewalls, and finally on the rear wall.

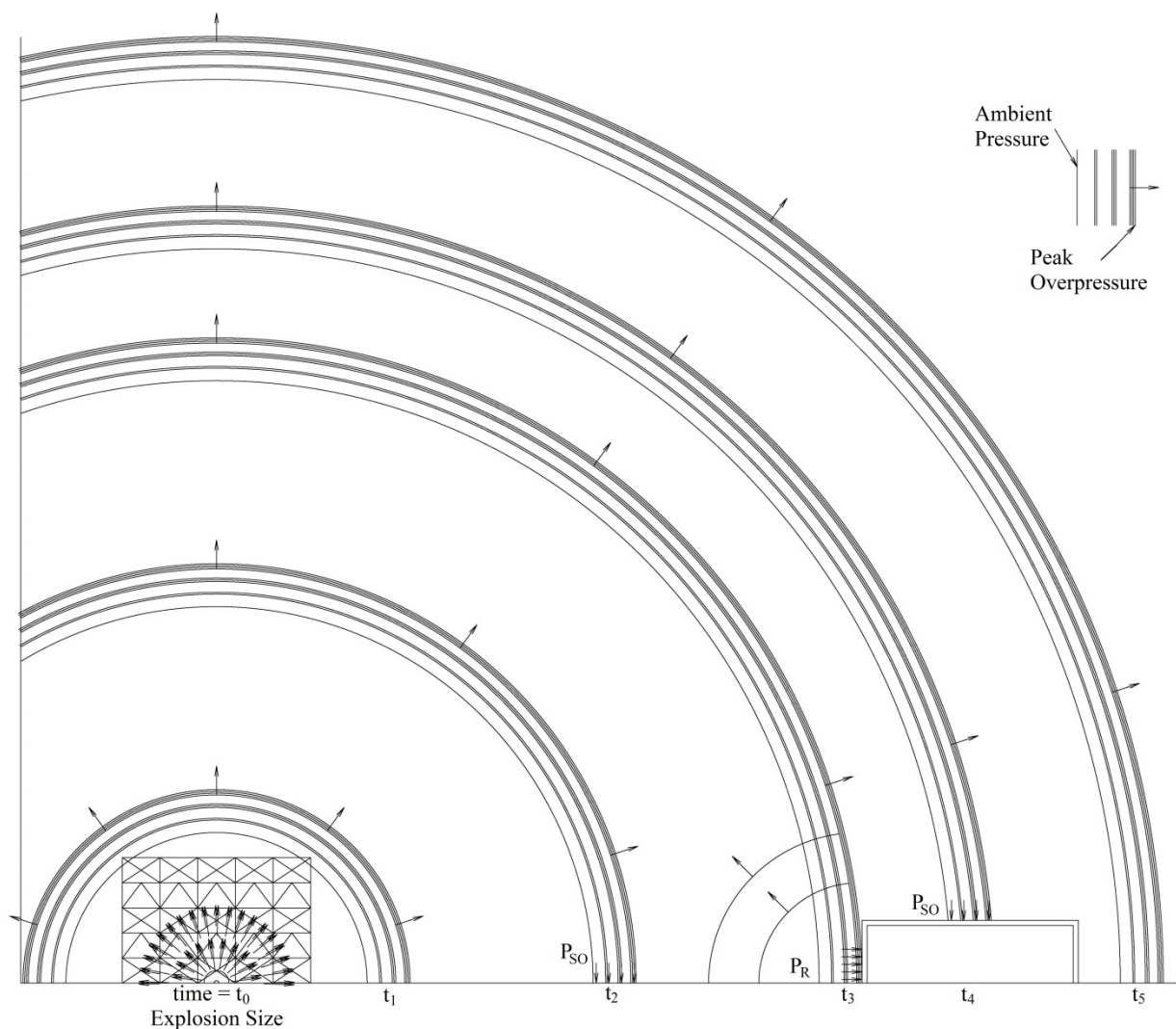


Figure 1—Pressure wave illustration

Building surfaces facing the blast will cause the overpressure wave to reflect off the building surface. As a consequence, the building surfaces facing the blast receive a higher overpressure load than the roof, side, or rear walls. As an example, the reflected pressure (P_R) on the front wall is approximately 2.2 times the peak pressure propagating in the free field. When providing specifications for building design, it is important to be clear whether side-on overpressure or reflected overpressure is being provided to the designer.

The peak overpressure value measured in the free field is called peak side-on overpressure (P_{SO}). This value is used as the quantifiable value characterizing the overpressure effect at the building location.

Unless otherwise noted, all references in this publication are to peak side-on overpressure.

4.5 Portable versus permanent buildings

Recommended practices in other industries, such as [API RP 753](#), have recognized that personnel in portable buildings can be more vulnerable to injury than personnel in permanent buildings [4]. This increased vulnerability can be attributed to the fact that portable buildings are traditionally of light-weight construction, and often located close to process equipment where work is being done.

Decisions regarding the specified damage-resistance and location of portable buildings in ASU and HYCO plants should take into account the consequences of VCEs and may include consequences of PV events taking place in or near the facility. Where risk-based analysis is being performed, the probability of such events should also be taken into account.

5 Selection of buildings for consideration in the building siting study

5.1 Preliminary considerations

Before siting buildings on the plot plan (facility layout), each building needs to be defined as either occupied or unoccupied. Depending upon the individual company's risk criteria, the peak occupancy may also need to be determined.

Portable buildings may be required for a defined period of time during the construction and the commissioning phase of new facilities and for future maintenance activities on the site. A building siting study should be done for these portable buildings if there is a desire to continue to have these portable buildings occupied during startup or operation of the plant or if neighboring plants that pose a risk will continue operations while the portable buildings are occupied, see 6.5.

Individual companies may develop their own occupancy criteria to define occupied buildings to be included or excluded from the building siting study as permitted by local regulations. For portable buildings, an occupancy probability of 1.0 shall be used in the study with exception of portable buildings not intended for occupancy as mentioned in [API RP 753](#) [4].

5.2 Buildings that should be included in a building siting study

Buildings or rooms within a building typically found at an ASU or HYCO facility that should be considered occupied during a building siting study include:

- office buildings;
- conference rooms;
- break rooms for drivers;
- buildings specifically designated as evacuation or safe haven locations in the event of an emergency;
- lunch rooms;
- control rooms;
- rooms used for work permit creation and control during maintenance activities;
- change houses or locker rooms;

- training rooms;
- guard houses;
- maintenance shops;
- laboratories;
- scale house;
- rooms intended for occupancy within an enclosed process area (e.g., office, maintenance shop, control rooms); and
- portable buildings used for the functions previously listed.

5.3 Buildings that may be excluded from a building siting study

Buildings typically found at an ASU or HYCO facility that should be considered unoccupied and therefore may be excluded from a building siting study include:

- Enclosed process areas where personnel are assigned to perform activities similar to those performed at an outdoor process area. This exclusion is included for consistency with [API RP 752](#) [3];
- Electrical substations and motor control buildings where routine personnel access is not typically required;
- Remote instrumentation and computer station enclosures where routine personnel access is not typically required;
- Enclosures used to store equipment or raw materials where routine personnel access is not typically required;
- Analyzer buildings where essential personnel are only required to perform short duration activities such as calibrations;
- Water or waste water treatment buildings where essential personnel are only required to perform short duration activities such as water treatment analysis; and
- Field sampling/testing station where personnel are only required to perform short duration activities such as sample collection.

Maintenance and calibration activities are not considered routine work for the purpose of this publication with the exception of dedicated maintenance shops and the work permit development and control activity. Additional guidance on classification of buildings as occupied or unoccupied can be found in [API RP 752](#) [3].

This publication does not require evaluation of unoccupied buildings.

6 Selection of scenarios for consideration in the building siting study

6.1 Introduction to scenarios

Scenarios for a siting study can include the following:

- energy releases resulting from ignition of flammable vapor released into congested or confined process areas, see 6.2;
- energy releases resulting from process upsets or deviations, see 6.3; and
- energy releases resulting from structural failure of vessels under pressure, see 6.4.

Some scenarios affecting occupied buildings in ASU or HYCO facilities can result from neighboring facilities. See 6.5 for additional discussion on how to address neighbor's impact on the siting of ASU or HYCO occupied facility buildings.

Scenarios determined by the company to be noncredible can be excluded from building siting consideration.

6.2 Vapor cloud explosion

6.2.1 Sources

A VCE can occur when flammable gas is released into a confined or congested area, when the gas is between its lower flammable limit (LFL) and upper flammable limit (UFL) and is ignited. The confinement or congestion results in a turbulent mixing of the released flammable gas with air, which increases the possibility of generating overpressures upon ignition.

Causes of flammable gas releases in facilities include but are not limited to:

- misoperation of valves to atmosphere;
- vessel or piping leaks due to corrosion, cracking, or expansion or contraction from large temperature changes;
- significant flange gasket failures;
- flex joint failures in piping;
- leaks from vibration (such as in compressor seals); or
- guillotine breaks of piping.

6.2.2 Excluded vapor cloud explosion sources

The following scenarios are typically excluded in the study because they are considered very low frequency sources of VCE or are addressed by existing industry publications or guidelines:

- All welded piping on pipe racks. Experience indicates that the frequency of failure for welded systems is much lower than flange or other mechanical joints;

NOTE—If welded piping systems are exposed to other hazards (e.g., vehicle traffic, forklift impact, etc.) they may be included as release sources in the study.

- Coldboxes that are inerted so a release of flammable material into this volume will not create a flammable mixture;
- Permanent flammable gas vents designed to direct the discharge to a safe location away from congested areas of the plant;
- Release of a flammable vapor into an uncongested and unconfined area. Field experiments have shown that the turbulence caused by congestion or confinement is required to initiate a significant overpressure event [7]. One example of this type of release is from an elevated process vent designed to prevent the release of gases from slumping into confined or congested areas;
- Release of flammable material inside small enclosures (not to exceed 1000 ft³), like analyzer buildings, which are equipped with flammable gas monitors, building ventilation, and ventilation monitoring systems;
- Release of flammable material inside enclosures, like analyzer buildings, where the only source of flammable material is from compressed gas cylinders stored and used in accordance with NFPA 55 [5]; and
- Refrigeration systems using class 2L refrigerants, such as ammonia, designed in accordance with local regulations or codes, such as ANSI/ASHRAE 15, *Safety Standard for Refrigeration Systems*, CSA B52, *Mechanical Refrigeration Code*, and EN 378-1, *Refrigerating systems and heat pumps. Safety and environmental requirements. Basic requirements, definitions, classification and selection criteria*, are excluded [13, 14, 15].

6.2.3 Included confined and congested spaces for vapor cloud explosions

Any area in which flammable gases or vapors could accumulate within a confined or congested area should be considered as a possible source of overpressure. The distance required for a structure to be considered as separate confined areas is discussed in [API RP 753](#) and the CCPS *Guidelines for Vapor Cloud Explosion, Pressure Vessel Burst, BLEVE and Flash Fire Hazards* [4, 8]. Examples of typical congested areas in ASU and HYCO plants include but are not limited to:

- equipment skids or process equipment areas;
- pipe racks;
- buildings that house equipment handling flammable gases;
- corridors between two plants or skids where there is interconnected piping;
- parking lots, adjacent wooded areas, or other process areas not handling flammable equipment where dispersion modelling suggests that a released flammable material could reach the confined area while still in the flammable range;
- natural gas metering, clean-up areas, filtering stations;
- reformer ancillary equipment;
- compressors;
- ambient air vaporizers;
- pressure swing adsorbers (PSA) valve skids;
- gaseous carbon monoxide and/or hydrogen trailer loading stanchions;
- flammable liquid or liquefied flammable gas storage areas including vaporizers;
- flammable gas storage; and
- syngas cooling equipment.

6.3 Process deviations

Process equipment failures can occur from deviations in the operating conditions that result in equipment being operated outside design limits. Catastrophic failure of pressure vessels due to process deviations can be minimized by good inspection and management procedures, application of design review techniques such as hazard review and risk quantification, and installation of proper protective devices such as pressure relief and instrumented systems. When these mitigation measures are applied, process deviation failures of pressure vessels in ASU and HYCO plants are so rare that they may be excluded from the analysis for these types of manufacturing facilities. This concept is supported by CIA's *Guidance for the Location and Design of Occupied Buildings on Chemical Manufacturing Sites* which indicates that the sudden failures of pressure vessels should not be the primary basis for the design of occupied buildings [5].

6.3.1 Included process deviations

Some of the included process equipment failures (unless excluded in the following list of scenarios) that may be considered include but are not limited to:

- vessel overpressure;
- low temperature material embrittlement;
- high temperature material failure (e.g., exceeding maximum design metal temperature or hydrogen embrittlement);
- temperature excursions in the purifier beds and catalyst beds;

- improper cooldown;
- runaway reaction;
- excessive vibration; and
- formation of flammable mixtures inside process equipment.

Each company should carry out its own risk assessments to identify these or other process equipment upset scenarios and include them in their safety analysis and mitigation practices. If the process hazard is reduced to a tolerable level, as defined by company guidelines, the systems previously listed may be excluded from the building siting study.

6.3.2 Excluded process deviations

The following excluded scenarios are considered to be very low frequency process deviations or failure mitigation methods are fully addressed by existing industry publications or guidelines:

- Reboiler explosions or liquid phase adsorber explosions as long as preventive measures as listed in EIGA Doc 142, *Major hazards* are in place [16]. A periodic audit program should be implemented to ensure that the required safeguards are in place and operational; and
- Major failure of flat bottom storage tanks are excluded as a major hazard scenario since the probability of such events is very low as long as preventive measures as listed in [CGA P-8.9](#), *Bulk Liquid Oxygen, Nitrogen, and Argon Storage Systems at Production Sites* are in place [17].

6.4 Pressure vessel mechanical failure

Mechanical failures of pressure vessels while operating within design conditions can result in the creation of an overpressure wave that can impact occupied facility buildings. For the purpose of this publication, mechanical failure of a pressure vessel is the unanticipated failure due to the undetected fatigue or material defects in that vessel. Material defects include manufacturing faults, such as flawed welds and incorrect material selection, or degradation of the vessel due to corrosion mechanisms. Fatigue can be caused by several conditions, including pressure cycling and vibration.

Experience in ASU and HYCO plants is that such failures are extremely rare. As such, pressure vessels or energy sources that may be excluded from the building siting study are:

- Vessels that are operated at less than 15 psi (103.4 kPa);
- Vessels for transport that are covered under local or regional transportation regulations (e.g., 49 CFR) where periodic revalidation is being performed in accordance with those regulations [18];
- Vessels used for permanent storage that are designed in accordance with local or regional transportation regulations (e.g., 49 CFR) and where periodic revalidation of container integrity is being performed at the frequency required for transport [18];
- Liquefied petroleum gas or propane gas cylinders or tanks used specifically for transportation fuel or liquefied petroleum gas tanks containing fuel for building heating purposes, which are located in accordance with NFPA 58, *Liquefied Petroleum Gas Code* or other regional regulations [19];
- All portable cylinders, defined by Title 49 of the U.S. *Code of Federal Regulations* (49 CFR) as having a water capacity less than or equal to 450 L (119 gal), such as acetylene and other portable gas welding cylinders when stored, handled, or used in accordance with NFPA 55, [CGA P-1](#), or other regional standards [18, 7, 20];
- Hot water heaters used solely to supply heated water to sinks and washrooms;
- Pressure vessels used solely in building heating, ventilation, and air conditioning (HVAC) systems;
- Cooling water heat exchangers where the pressurized gas is on the tube side of the exchanger, and the shell side is protected from the overpressure that can result from a leak of one of the tubes;

- Piping systems, because there is no recognized method to determine the fraction of the piping volume that would participate in a PV energy release and the location of the energy release point within the length of pipe;
 - Vacuum-insulated pressurized cryogenic storage tanks (stationary cryogenic storage vessels) as industry experience with these tanks indicates a very low failure frequency for these types of systems as shown in EIGA Doc 60, *Prevention of major accidents. Guidance on compliance with the Seveso II Directive* [21];
 - Pressure vessels in coldboxes based on operating experience, the inherently stable and benign conditions within an operating cryogenic plant and an absence of the traditional failure mechanisms for such equipment; namely corrosion, erosion, fatigue.
 - Pressure vessels that comply with the *Pressure Equipment Directive* (97/23/EC) [22];
 - Pressure vessels designed for leak-before break (LBB) vessel fracture performance as described in *Fracture and Fatigue Control in Structures, Applications of Fracture Mechanics; Structural Integrity Assurance of High-Strength Steel Gas Cylinders Using Fracture Mechanics; Technical Basis for Flawed Cylinder Test Specification to Assure Adequate Fracture Resistance of ISO High-Strength Steel Cylinders* and that meet all of the following criteria [23, 24, 25]:
 - Fracture toughness of the material is high enough to tolerate through thickness crack at design stress corresponding to the maximum allowable working pressure (MAWP)
 - Coded vessel per ASME or equivalent local pressure vessel codes (shall include nondestructive examination of vessel welds equivalent to code requirements) [26]
 - Constructed of materials resistant to corrosion and stress corrosion cracking at the service conditions or periodically inspected for signs of corrosion and stress corrosion cracking.
- NOTE—The inspection method, frequency, and results should be documented.
- Protected from overpressure due to maximum credible inflow of process fluids by a pressure relieving system (relief valve, rupture disk, depressurization system or a combination of these devices) on the vessel or the upstream source; and
 - Pressure vessels not designed for LBB vessel fracture performance if the following criteria are met:
 - Defects or deterioration mechanisms (e.g., material flaws due to specification or fabrication errors, erosion, corrosion, stress corrosion cracking, cyclic fatigue, etc.) that can lead to a vessel failure have been identified and
 - Vessels are periodically inspected for the identified defects or deterioration mechanisms and the results are evaluated for continued safe operation.

NOTE—The inspection method, frequency, and results should be documented.

Other sources of pressure vessel mechanical failure can be minimized through good inspection and management procedures and appropriate materials selection. When these mitigation measures are applied, pressure vessel mechanical failure sources not previously listed are so rare they may be excluded from the analysis for these types of manufacturing facilities. This is also supported by CIA's *Guidance for the Location and Design of Occupied Buildings on Chemical Manufacturing Sites*, which indicates that the sudden failures of pressure vessels would not be the basis for the design of occupied buildings [5].

6.4.1 Pressure vessels to be considered for HYCO facilities

Unless excluded as allowed in 6.4, pressure vessels that should be considered in the building siting study for a HYCO facility include, but are not limited to:

- vessels in syngas trains including carbon dioxide absorber and stripper columns, drums and separators;
- PSA vessels including PSA tailgas;
- desulfurizers;