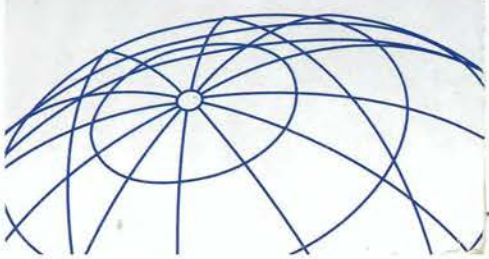
LP Gas Safety

Guidelines for Good Safety Practice in the LP Gas Industry

United Nations Environment Programme

UNEP

The World LPG Association



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This publication which should be considered as a guideline and not as an instruction, is designed as a practical contribution towards good safety practice in the LP Gas industry.

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Foreword

United Nations Environment Programme - Industry and Environment

Safety is one of the key requirements for successful industrial environmental management. Major technological accidents over the years have taught us that the effects do not necessarily stop at the factory fence but can affect people, property and the environment outside the enterprise, sometimes at considerable distances.

"Prevention is better than cure" and effective safety promotion starts by getting things right within the factory, storage depot or transport system. However, the importance of having an effective emergency management system, for the occasion when something does nonetheless go wrong, has been recognised for a long time. International Standard ISO 14001, "Environmental Management Systems – Specification with Guidance for Use" reinforces the point in paragraph 4.4.7:

- *the organisation shall establish and maintain procedures to identify potential for and respond to accidents and emergency situations, and to prevent and mitigate the environmental effects that may be associated with them.*
- *the organisation shall review and revise, where necessary, its emergency preparedness and response procedures, in particular after the occurrence of accidents or emergency situations.*

Five years after the Earth Summit of 1992, the UN General Assembly Special Session of 23-27 June 1997 also reminded the international community of the need to intensify co-operation in order to prevent and mitigate major technological and other disasters, which can be a substantial obstacle in the way of achieving the goals of sustainable development in many countries.

UNEP's Awareness and Preparedness for Emergencies at Local Level (APELL) programme, introduced in 1988 in co-operation with governments and the chemical industry, responds to this need by helping to prevent technological accidents and their impacts through partnerships. The APELL process which UNEP promotes has the following aims:

- *make industry, the emergency response authorities and the community at large aware of hazards within a community*
- *develop a co-ordinated emergency response plan which effectively handles accidents which could develop into major disasters*
- *train residents of a community on how to act in the event of an emergency*

APELL has been introduced in around thirty countries throughout the world.

Industry all over the world has a vital role to play in accident prevention and ensuring that the sustainable development process is not threatened by the effects of technological disasters. UNEP is pleased that the WLPGA is contributing to this world-wide effort by preparing and disseminating these Safety Guidelines. They will contribute to the process of sharing safety expertise as widely available as possible within the international LP Gas industry, so as to encourage continuous safety improvement throughout the world.

Contents

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Introduction

LP Gas is an excellent, environment-friendly fuel with tens of millions of satisfied consumers in every part of the world.

Like all forms of energy, LP Gas is potentially hazardous if mis-handled, or mis-used. The promotion of safety is a key aim of The World LPG Association.

The Guidelines are intended for non-experts who may have responsibility for, or are otherwise concerned with, good practice in relation to LP Gas handling, distribution and use.

Introduction

These Guidelines have been developed by The World LPG Association to form the central part of a Safety Promotion Project. The promotion of LP Gas safety is one of the key aims of the Association.

While safety is an important issue, it should be emphasised that LP Gas is an excellent and versatile fuel - the preferred fuel for many applications - with tens of millions of satisfied consumers throughout the world. It is also a recognised environment - friendly fuel.

As with all forms of energy, LP Gas is potentially hazardous if mis-handled or mis-used. Care in the handling and use of LP Gas can help to minimise the number of accidents and their consequences. This is the reason for the Safety Promotion Project and for these Guidelines.

There is, within the LP Gas industry, a wealth of knowledge and experience which is used to enhance safety and which is reflected in these Guidelines. It is the policy of The World LPG Association that the safety expertise available within the international LP Gas industry should be shared as widely as possible in the interest of participants, consumers and the community.

The Guidelines are intended for policy makers, government officials and industry managers at international, national and local levels who are concerned with good safety practice in relation to LP Gas handling, distribution and use.

The hazards commonly associated with LP Gas are fire and explosion following uncontrolled releases. The Guidelines address such hazards but they also take a more comprehensive view of LP Gas safety.

In structure, the Guidelines follow the LP Gas distribution chain up to, and including, the point of use. Hazards are identified at each stage of the process and good safety practices are outlined. References are provided for more detailed technical guidance.

Key Responsibilities

The principal participants in the LP Gas industry - marketers, equipment manufacturers, transporters and installers - all have responsibilities in the area of safety. They should collaborate to ensure the efficient discharge of their responsibilities.

National and local authorities should take advantage of the expertise within the LP Gas industry to ensure an informed and uniform approach to good safety practice.

Consumers should adhere to the safety instructions which are provided for them.

References of Chapter 1 (see Appendix III)
G 1, 2, 3
T 1, 2, 3, 4, 5, 6, 27, 28, 29, 30, 31, 34, 36, 38.

1.1 - LP Gas Marketer / Supplier

1.1.1 The LP Gas marketer / supplier may be an importer, a primary marketer or a distributor appointed by the marketer. It may be a state-owned or private-sector enterprise.

1.1.2 The marketer / supplier will be responsible for the quality of LP Gas supplied, i.e. for conformity with a declared standard or specification, and for quantity, i.e. for conformity with a declared volume or weight.

1.1.3 If, as is often the case, the marketer / supplier retains ownership of the tanks and cylinders used to supply LP Gas, then he should ensure conformity with prescribed, or declared, manufacturing standards and with specified periodic inspection or requalification procedures.

1.1.4 The marketer / supplier should be encouraged to work closely with manufacturers, suppliers and installers of LP Gas appliances and equipment as part of a co-ordinated industry approach to good safety practice. The Marketer / Supplier should use his influence with appliance and equipment manufacturers and installers to promote safety in their mutual interest.

1.2 - Appliance Manufacturer / Supplier

1.2.1 Manufacturers of LP Gas appliances usually distribute them through suppliers who may be sellers of household appliances and / or who may be LP Gas suppliers. Where a manufacturer based in another country sells through an import agent, the agent should fully understand the required safety standards and the safety implications for the users.

1.2.2 Virtually all commercial, household and leisure applications for LP Gas require an appliance. Some appliances are made specifically for LP Gas but, more often, commercial and household appliances are manufactured primarily for use with natural gas.

1.2.3 Only LP Gas appliances should be used with LP Gas. It is a key responsibility of the supplier to ensure that his LP Gas appliances are capable of safe, efficient operation with the grade, or grades, of LP Gas being sold in the market. Suppliers should provide clear operating and safety instructions for the user.

1.2.4 Suppliers of LP Gas and of appliances should collaborate to ensure that consumers are offered a choice of appliances which are fuel-efficient and which can be operated safely in particular markets.

1.3 - Equipment Manufacturer / Supplier

1.3.1 LP Gas equipment includes a variety of products associated with handling and use, such as storage tanks, cylinders, pressure regulators, gauges and controls. These include small volume / high value and mass-produced, high precision items.

1.3.2 Equipment may be installed in an LP Gas marketer's plant, on a truck or pipeline, at a consumer installation or at the immmediate point of use. Manufacturers and suppliers should ensure that the equipment being used is suitable for the intended purpose.

1.3.3 LP Gas marketers should take a direct, informed interest in the equipment which they employ and recognise the relationship between quality and safety. Sub-standard equipment increases risk and, therefore, should have no place in the LP Gas industry. Enforcement may be by national type approval and / or product approval or by a voluntary code.

1.4 - Installer

1.4.1 The function of the installer is to put the LP Gas supply in place using appropriate equipment and, having connected the supply to the appliance, to ensure the system is working correctly. The installer shall be a competent person of certified proficiency.

1.4.2 While the LP Gas supplier will be responsible for any installed equipment which remains his property, it is usually the installer who introduces the consumer to the safety features of the installation.

1.4.3 Key responsibilities of the installer include that:

- His work is in conformity with any statutory requirements;
- The installation is gas-tight and, as far as practicable, secure from damage or interference;
- Adequate combustion air is available and that the products of combustion will be safely disposed of;
- Controls and safety systems are functioning correctly;
- The consumer understands the normal operation of the installation, its maintenance needs and the action to be taken by him in an emergency.

1.5 - Consumer

1.5.1 Because of the wide range of LP Gas applications, and the variations in the scale of usage, there are many categories of consumer. These range from households (often the largest single category) to industrial or chemical complexes where LP Gas may be only one of many hazardous products.

1.5.2 The "duty of care" concept increasingly found in the Western European approach to safety and the "duty to inform" found in the US are very appropriate for LP Gas consumers and could usefully be adopted by other countries. Duty of care includes an obligation on the consumer to heed the safety information provided by the supplier as part of his duty to inform.

1.5.3 The consumer should be supplied with safety notices and instructions. Having been supplied, he should heed them and avoid a cut-price, or "do-it-yourself" approach to LP Gas installations. Some LP Gas applications, especially those in the leisure sector, lend themselves to self-assembly but most require the services of a competent installer.

1.6 - Industry Association

1.6.1 The key responsibility of a national or local LP Gas industry association should be the promotion of good safety practice in the LP Gas industry. It should have a mission and the structure which facilitates the progressive raising of technical and safety standards.

1.6.2 Membership of an LP Gas industry association should be open to the appliance, equipment, transporter and installer sectors, as well as to LP Gas marketers.

1.6.3 National LP Gas associations should have a coordinating role in the preparation of LP Gas-related legislation.

1.7 - National and Local Authorities

1.7.1 Typically, LP Gas represents a small component of national energy supply, especially in countries with well-developed natural gas and electricity distribution networks. However, the use of LP Gas is sometimes encouraged for specific energy-related, or environment-related reasons, such as the replacement of wood fuel or CFCs, or as an alternative transportation fuel. National Authorities should ensure that they, and the relevant public bodies, understand and address safety issues in respect of LP Gas handling, distribution and usage. They should appreciate and accept the safety implications of promoting, or permitting, particular applications.

1.7.2 A National Authority should ensure that appropriate technical and safety standards are in place for LP Gas, LP Gas appliances, equipment and installation. It is usually quite practical, and sometimes more efficient, to adopt standards which have good international recognition rather than develop national standards from first principles. The emphasis should be on adoption, not adaptation, as long as it does not contradict other adopted practices and suits the local operational environment.

1.7.3 National and Local Authorities should initiate, or encourage, dialogue with the LP Gas industry to ensure an informed and uniform approach to good safety practice. At national and international level, the LP Gas industry is encouraging a scientific and risk-based approach to such matters as land use planning.

1.7.4 A Local Authority will probably be responsible for sanctioning the development of the LP Gas distribution infrastructure and the routing of LP Gas transportation. It may also be responsible for sanctioning the operation of elements of the distribution infrastructure, such as cylinder filling plants. These Guidelines are intended to assist Local Authorities in the exercise of such duties.

Regulatory Framework

LP Gas safety may be regulated directly or within the broader regulation of hazardous substances and activities.

The regulatory system should promote safety in storage, handling, transportation and use.

The LP Gas industry should have a role in the preparation of regulations through its national or other representative association.

References of Chapter 2 (see Appendix III)
G 1, 3, 4
T 8, 15, 16, 36, 38.

2.1 - General

2.1.1 In these Guidelines we are concerned only with the regulatory framework for safety.

2.1.2 In countries which have wide-ranging systems of regulation for public, worker and consumer safety, it is normal to find LP Gas included in schedules of hazardous substances. Typically, such systems provide for regulation of many substances, in storage, handling, transportation and use.

2.1.3 In the absence of such wide-ranging systems, regulations may be introduced specifically for LP Gas, or the LP Gas industry may be self regulating. Self-regulation is usually on the basis of recognised technical standards and codes of practice, accepted and overseen by an official inspectorate.

2.2 - Points to be Regulated Directly

2.2.1 The most serious events tend to be associated with large quantities of LP Gas in storage or transportation. Such events may be infrequent but will probably have consequences beyond their immediate location.

2.2.2 The location of LP Gas storage and handling facilities should be directly regulated within general hazardous substances regulations or, in their absence, by LP Gas-specific regulations. A threshold level of inventory should be set which will determine whether a facility falls within the scope of the regulations. Progressively more stringent conditions should apply as the assessed risk increases.

2.2.3 Planning regulations should take account of the potential hazard, the hazard consequences and the probability of the occurance of hazardous events.

2.2.4 The operation of LP Gas storage and handling facilities may be subject to license which sets limits to the capacity, throughput and scope of activities. The license should provide for periodic inspection and renewal.

2.2.5 LP Gas transport should be regulated to take account of the inherent hazard and the risks associated with the transportation mode, e.g. pipeline, water-borne, rail, road. Where national or local regulations are deemed to be inadequate, or in need of strengthening, a code should be adopted which has international recognition.

2.2.6 Many of the incidents (including fatalities) involving LP Gas occur at, or close to, the point of use. They may result from defects in the LP Gas supply, in the appliance, the equipment or the manner of installation. Some incidents are the result of mis-use by the consumer. Such mis-use may be accidental or due to the consumer being inadequately informed: in the extreme, it may not be accidental but deliberate.

2.2.7 Broad-based consumer protection regulations will provide a measure of safety for LP Gas users. The emphasis in direct regulation should be on:

- LP Gas of the specified grade and standard in containers (tanks and cylinders) manufactured and maintained to the appropriate standard;
- Appliances and equipment manufactured and installed to the appropriate standards;
- Type approval procedures and the exclusion of sub-standard appliances, equipment and installers.

2.3 - Points to be Regulated Indirectly

2.3.1 Where well-developed systems for the regulation of public, worker and consumer safety are in place and effective, many aspects of LP Gas safety can be regulated indirectly. However, it is important that, when LP Gas is included in such regulatory systems, the potential hazards are correctly identified and the risks quantified to an acceptable level of accuracy.

LP Gas Safety

PROPANE

BUTANE

LP Gas is potentially hazardous from production until it has been used and the combustion products have been safely disposed of.

Safety comes from understanding the behaviour of LP Gas and keeping it under control.

Every uncontrolled release is a hazardous event and should receive urgent attention. As pure LP Gas is odourless and invisible, a distinctive odour is usually added to warn of its presence. Thus even the smallest leak can be detected and can receive appropriate attention.

Consumers should be given safety information and, having been informed, should exercise reasonable care in handling and use.

LP Gas describes a range of products which have much in common but also have differences which affect safety.

LP Gas containers should be readily identifiable as such.

Good appliance and installation standards are essential for safety.

References of Chapter 3 (see Appendix III)
G 1, 3, 4
T 1, 2, 3, 4, 5, 6, 7, 8, 20, 36, 38.

3.1 - General

3.1.1 The term LP Gas is an abbreviation for Liquefied Petroleum Gas and refers to hydrocarbon products, sometimes also described as light fractions. In common with other forms of energy, LP Gas can be hazardous unless it is kept under control. It is potentially hazardous from the time of production until it has been used and the products of combustion have been disposed of safely.

3.1.2 LP Gas has its own special hazardous characteristics. LP Gas safety comes from understanding these characteristics and behaviour and from the exercise of control under both normal and abnormal conditions.

3.1.3 The behaviour of LP Gas is predictable and the technology for control is well understood. Good technical and safety expertise is to be found in the primary marketing companies and in the major equipment manufacturers. The application of this expertise becomes progressively more difficult as LP Gas is moved along the distribution chain and away from the direct control of the primary marketers.

3.1.4 The hazards commonly associated with LP Gas are fire and explosion. Since uncontrolled releases of LP Gas can have serious consequences the prime objective of an LP Gas safety programme is to prevent them. However, there are other hazards inherent in handling, distribution and use which are addressed in these Guidelines.

3.1.5 Butane and Propane are the predominant constituents of LP Gas. Butane, Propane and LP Gas (i.e. Butane / Propane) mixtures are sometimes handled and / or distributed separately and, for safety, one product should not be mistaken for the other.

3.1.6 The consumer receives LP Gas at the end of a distribution chain. In practice, this can mean transportation over long distances and, probably, one or more transhipments. LP Gas safety must take into account hazards associated with the mode and duration of transport including the risk of traffic accidents and their possible consequences.

3.1.7 Most LP Gas is used by combustion in an appliance which is itself part of a consumer installation. Adequate combustion air and ventilation are essential for safety. The products of LP Gas combustion should be vented to avoid a possible build-up of hazardous secondary products. The installer and the consumer have major roles in this aspect of LP Gas safety.

3.1.8 The range of LP Gas uses and of appliances, as well as the variable scale of installations, add to the complexity of LP Gas safety.

3.1.9 Introduction of new applications, especially when accompanied by changes in distribution practices present new hazards and may call for the introduction of additional safety practices. The safety procedures in a marketer's bulk plant may not be adequate at an automotive re-fuelling station. The safety requirements of a household installation with several appliances, e.g. stove, water heater and space heaters will differ from those of a consumer using a single appliance directly attached to a cylinder.

3.2 - Physical Properties

3.2.1 LP Gas is produced in oil refining and the processing of natural gas liquids. Commercial, or fuel grade, LP Gas mainly consists of Butane and Propane with small amounts of lighter and heavier fractions, such as Ethane and Pentane.

	Propane	IsoButane	n-Butane
Boiling point at 101.3 kPa (°C)	-42.1	-11.8	-0.5
Liquid density at 15 °C (kg / m³)	506.0	561.5	583.0
Absolute vapour pressure at 40 °C (kPa)	1510	530	375
Flash Point (°C)	-104	-83	-60
Upper flammable limit (% vol. in air)	9.5	8.5	8.5
Lower flammable limit (% vol. in air)	2.3	1.9	1.9
Vol. vapour per vol. liquid	269	221	235
Relative vapour density (air = 1)	1.55	2.07	2.07
Coefficient of expansion (liquid) per 1°C	0.0032		0.0023
Minimum air for combustion (m³ / m³)	24		30

3.2.2 It will be apparent from the Table that there are significant differences in the physical properties of Butane and Propane. The values for LP Gas mixtures generally lie between these extremes, depending on the ratio of Butane to Propane in them. However, quite small amounts of methane and ethane can have a significant effect on vapour pressure.

3.2.3 The differences in their physical properties mean that Butane and Propane behave differently under everyday conditions and more especially under extreme conditions. Such differences can be turned to advantages in certain applications. However, differences in boiling point, liquid density and vapour pressure between Butane and Propane are particularly important for safety.

3.2.4 Differences in the quantity of air required for complete combustion of Butane and Propane should be taken into account by appliance suppliers and installers. Failure to do so can affect both consumer safety and satisfaction.

3.2.5 Poor quality control in LP Gas refining and production processes can have an indirect bearing on safety as it may lead to hazards further along the distribution chain or at the point of use. Well-intentioned but inexpert attempts to solve LP Gas quality problems at the point of use can be risky and are best prevented by appropriate controls during production. Authorities should ensure, as far as reasonably practical, that product standards are established and observed.

3.2.6 Because Butane and Propane have different physical properties, it is important that the composition of LP Gas mixtures being distributed in a market be known to participants and kept within specified limits. There are LP Gas standards which have international recognition and one of which could be adopted, in the absence of a suitable national standard. See Appendix III - References.

3.2.7 A distinctive odour is usually added to LP Gas in order to warn of its presence. However, not all LP Gas is odorised in this way.

3.3 - Inherent Hazards / Potential Risks

3.3.1 The principal potential hazard with LP Gas is fire. This derives from its inherent quality of high flammability and in extreme cases may combine with another quality, i.e. pressure, and lead to the BLEVE (Boiling Liquid Expanding Vapour Explosion) phenomenon. There are also hazards incidental to the various modes of transport for distribution and use.

3.3.2 An additional potential hazard may arise at the point of use if the products of combustion are not dispersed into the atmosphere and carbon monoxide is allowed to develop. LP Gas "sniffing" i.e. the intentional inhalation of LP Gas vapour seeking a narcotic effect, can result in injury or, in extreme cases, death.

3.3.3 The risk associated with such hazards (with the exception of sniffing) can be controlled using available, proven technology, i.e. the safety equipment and procedures normally used by the LP Gas industry.

3.3.4 Liquid LP Gas can cause cold burns if it comes into contact with the skin. Propane, with its low boiling point is more hazardous in this respect than Butane which, in cold conditions, is slower to vaporise and disperse. The eyes and body must be protected when handling liquefied products.

3.3.5 LP Gas vapour, being heavier than air, may, in the event of a leak, accumulate in confined spaces and low-lying areas. The means of ventilation will influence the movement and dispersion of the LP Gas vapour.

3.3.6 Any uncontrolled release of LP Gas is inherently hazardous. A liquid LP Gas leak is considered more hazardous in that it will expand to vapour by a factor in excess of 200. Being heavier than air, vapour will tend to lie, or drift, close to the ground with a risk that it will find a source of ignition while it remains within its flammable limits. (See Table on page 18).

3.3.7 Liquid LP Gas has a high co-efficient of thermal expansion and, therefore, cylinders and tanks should be filled with an ullage to allow for liquid expansion as a result of an increase in temperature. This potential risk is further controlled by a combination of safety devices and procedures and especially by control during product transfer operations.

3.3.8 Because of its much higher vapour pressure, tanks and cylinders containing Propane need to be stronger than those for Butane, and should be protected against excessive pressure. This potential risk is controlled by safety devices and by segregating the products or, where LP Gas mixture is handled, ensuring that the Propane content does not exceed a specified upper limit. In cold weather, a tank storing Butane may be subjected to negative pressure and must be capable of withstanding this.

3.3.9 During the process of distribution, LP Gas will normally be transported in one or more modes. There will be hazards associated with the transport mode and with the consequences of traffic accidents. The risks will vary from country to country and with the transport mode. The control of transport-related risks is discussed in Chapters 6 and 9.

3.3.10 The majority of consumers will use LP Gas as a fuel in an appliance. The installation comprising the LP Gas supply and connection to the appliance may be simple or complex, large or small. Hazard scenarios and risk at the point of use are discussed in Chapter 10.

3.3.11 The products of LP Gas combustion - mainly water and carbon dioxide - are not inherently hazardous. Good installation practice specifys ventilation to supply the air required for combustion and to vent the products of combustion. This minimises risk by preventing a build-up of carbon monoxide or a development of asphixiating (i.e. oxygen-deficient) conditions.

3.3.12 LP Gas is a clear odourless liquid and is not readily visible in its gaseous phase. In the event of a leak it may be present, unseen, in hazardous concentrations. To minimise this risk, odorant with a distinctive, unpleasant smell is added to LP Gas prior to distribution. In special appplications requiring odour-free LP Gas, such as aerosol propellant, or the chemical industry, alternative safety measures are adopted.

3.3.13 Accumulation of LP Gas vapour may result in the development of an oxygen-deficient atmosphere which carries a risk of asphixiation. No one should enter a tank which has been used for LP Gas storage without supervision and only when all appropriate safety measures are in place.

3.3.14 In most activities, zero risk is an aspiration rather than an absolute certainty. Guidelines such as these allow for the management of LP Gas operations, and for its use, well within the parameters for individual and societal risks acceptable in a modern, industrialised society.

3.4 - Basic Safety Principles

3.4.1 While flammability is the major safety concern with LP Gas it is not the only one. Good safety practice addresses the various hazards from production to consumption.

3.4.2 The term LP Gas embraces several products which, while related, have important physical differences which, in turn, affect safety. If more than one type or grade of LP Gas is being handled each should be clearly identified and segregated. All should be within specification, especially with respect to maximium permitted vapour pressure.

3.4.3 Large LP Gas installations should not be constructed close to large or sensitive populations. Equally, populations should be restricted close to locations approved for large LP Gas installations. In planning, or evaluating proposals for the location of LP Gas facilities, due account should be taken of the hazards created and of the risks associated with those hazards within and beyond the facility.

3.4.4 Space and separation distances are fundamental to safety at LP Gas facilities - large and small - and should be observed.

3.4.5 Participants in the LP Gas industry should actively promote a safety culture within their own businesses and at industry level.

3.4.6 Personnel engaged in LP Gas operations should receive formal, professional training for their normal activities and for emergencies. LP Gas facilities should have emergency planning and response programmes appropriate to the hazards and risks which they represent.

3.4.7 Fuel grade LP Gas should be adequately odorised prior to entering the distribution chain. When LP Gas is required to be odour-free, adequate alternative safety measures should be employed. (See Appendix III - References).

3.4.8 LP Gas cylinders and tanks should never be allowed to become "liquid-full". A maximum of 80 per cent of water capacity is generally observed. In some circumstances stop-fill devices may be required as protection against over-filling.

3.4.9 LP Gas should be clearly identified during transportation, using classification numbers and appropriate warning signs. (See Appendix I).

3.4.10 Appliances and equipment for the handling, transportation and use of LP Gas should be fit-for-purpose, correctly installed and well-maintained. Sub-standard appliances, equipment and installations should be excluded - if necessary, by regulation.

3.4.11 Installers of appliances and equipment, and those responsible for service, should be formally trained and should have reached a specified level of proficiency.

3.4.12 Cylinders for indoor use should preferably be filled with Butane or Butane-rich LP Gas mixture, although certain countries do permit the use of Propane cylinders indoors. Only those cylinders which are in use should be kept indoors. In markets where Butane and Propane are sold as separate products, cylinders should be readily distinguished and, preferably, fitted with different outlet valves so that they are not easily interchanged.

3.4.13 Consumer safety awareness campaigns are an essential part of LP Gas safety principles and they should emphasise:

- The quality / safety linkage for gas, appliances and equipment;
- The risks associated with inferior installation standards and / or practices;
- The need for care and, in particular, for adequate ventilation;
- How to recognise the smell of odorised LP Gas;
- The action to take when gas is detected.

3.5 - Product Classification and Labelling

3.5.1 In practice, the products known collectively as LP Gas include n-Butane, iso-Butane, Propane and Propene / Propylene, which may be supplied separately or in varying mixtures and degrees of purity. All come within the designation "Hazardous Substances" and are classified "Highly Flammable".

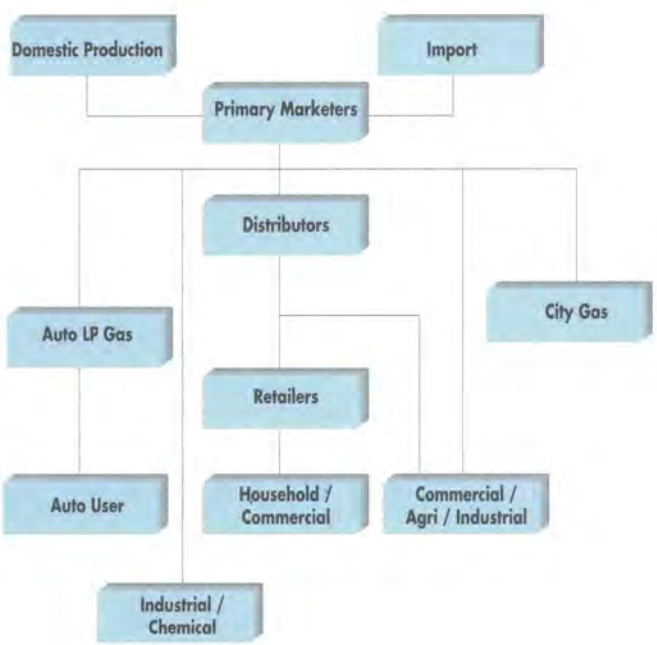
3.5.2 Transport regulations, such as the Agreement for the International Transportation of Dangerous Substances by Road - ADR - and its railway counterpart - RID - include a UN hazard warning and identification system which is useful in emergencies and which should be used. Examples of the system are to be found in Appendix I.

3.5.3 LP Gas cylinders, storage tanks and pipelines should be clearly identified by appropriate markings and warning signs, examples of which are to be found in Appendix I. These are recomended for use, in the absence of a national system of signs and markings.

3.5.4 Where Butane and Propane are sold as separate products, cylinders and tanks should be marked according to product. Containers of LP Gas which has not been odorised should be marked or labelled accordingly.

3.5.5 In the absence of national regulations, the minimum safety information on a cylinder should state the product, the supplier's name or brand, the net fill amount, a flame symbol and the word "Flammable", or its local language equivalent. Information should be of sufficient size to be readily legible and in a colour contrasting with the rest of the cylinder.

LP Gas Distribution Chain



The chain begins with a small number of large installations and ends with large numbers of consumers - some large but mostly small.

Some consumers receive LP Gas in cylinders - others receive it in bulk.

Safety should take account of the distribution system, the different types of consumer and the particular hazards at each stage of the chain.

The exercise of safety becomes more difficult as LP Gas moves outward along the distribution chain.

References of Chapter 4 (see Appendix III)

G 3
T 36.

4.1 - General

4.1.1 The Distribution Chain describes the process by which LP Gas is moved from production, or importation, to the point of use.

4.1.2 LP Gas purchased ex-ship, or ex-pipeline, is considered to have entered the distribution chain at the point and time of custody transfer, when ownership and responsibility normally passes to the primary marketer. At this early stage of the distribution process, Butane and Propane are often handled separately and the scale of operations tends to be at its largest.

4.1.3 Normally, LP Gas is stored, handled and transported under pressure and at ambient temperature during distribution. Marketers will seek competitive advantage through distribution efficiency which will include optimising the scale and location of their distribution infrastructure. In practice, this will include locating certain of their facilities close to consumption centres and may bring the marketers into confrontation with local interests.

4.1.4 LP Gas distribution may be in bulk or in cylinders, depending on many considerations, such as application, scale of usage and consumer preference. Automotive LP Gas should always be distributed in bulk. The marketers' distribution infrastructure will include bulk depots and, unless solely engaged in Automotive LP Gas, cylinder filling plants.

4.2 - Classification and Activities

4.2.1 In its basic form, the LP Gas distribution chain starts with a primary marketer purchasing a single grade of LP Gas - probably the producer's specification - and selling it to consumers within a limited geographical area. The chain becomes more complex as multiple supply sources and, possibly, a choice of grades develop. More marketers begin to sell into an expanding geographical area and serve a broader range of LP Gas applications.

4.2.2 Importation of LP Gas may be required to augment indigenous supply on a seasonal and / or year-round basis. It will further complicate the distribution chain.

4.2.3 Imports may be made overland but are more commonly made by sea. Sea-fed facilities may be established by specialist terminalling or trading companies, by LP Gas marketers or by joint ventures. It is unlikely that a marketer whose experience is limited to purchasing LP Gas ex-refinery, or gas plant, will have the technical and safety skills to handle imports without expert assistance.

4.2.4 Multiple sources will normally enable the marketer to extend his supply options and, possibly, to shorten his primary transportation lines. He will probably be drawn towards multi-depot operations and should then be prepared to deploy additional supervision in order to maintain safety standards.

4.2.5 Some marketers distribute directly to their consumers - large and small. Oil companies with retail businesses sometimes use their petrol stations as LP Gas outlets. Others distribute through appointed agents, distributors or dealers. All must work to implement LP Gas safety disciplines in distribution networks which may include some unresponsive elements.

4.2.6 A developed LP Gas distribution chain will have some - possibly all - of the components shown in the diagram on page 25. In addition, it will include traders and transportation companies - shippers, pipeline operators, rail and road transport contractors.

4.3 - Implementation of Basic Safety Disciplines

4.3.1 The effective implementation of safety disciplines should follow from the regulatory / enforcement system working constructively with industry, both directly and through its representative organisations. For our purpose, industry should include appliance and equipment vendors and installers, as well as LP Gas marketers.

4.3.2 Elsewhere in the Guidelines, we have noted that:

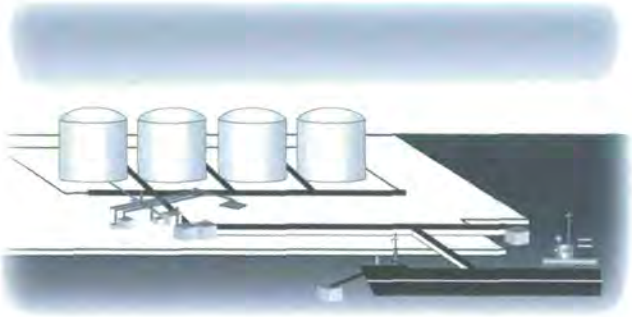
- LP Gas can be hazardous from production to the point of use.
- Safety comes from understanding LP Gas and maintaining control.

Obviously, understanding and control should be present, and exercised, at every point of the distribution chain.

4.3.3 The logical starting points for the process of implementing safety discipline are knowledge and awareness. We have noted that good technical expertise is to be found in the LP Gas marketing companies and equipment manufacturers. The main burden of implementing knowledge-based safety and safety awareness should be borne by them and they should have recognition when it is done properly.

4.3.4 The majority of LP Gas-related incidents occur at, or close to, the point of use. Safety discipline must include the consumer who, having been made aware of certain hazards, should respond by exercising every reasonable care.

Trans-Shipment Terminal



LP Gas trans-shipment terminals are always major hazard installations whether by reason of their capacity, the scale of transfer operations and / or proximity to other hazardous installations.

The planning and operation of a trans-shipment terminal should be the subject of hazard and environmental impact studies, using quantified risk assessment (Q.R.A.) techniques.

In many terminals, Butane and Propane will be handled separately rather than as LP Gas mixtures. The products may be received and stored at sub-zero temperatures. Safety systems should take account of these factors.

Terminal safety is directly linked to the safety of shipping operations.

References of Chapter 5 (see Appendix III)
G 3
T 9, 10, 11, 12, 13, 14, 15, 16, 17.

5.1 - General

5.1.1 Markets in which LP Gas demand exceeds indigenous supply tend, sooner or later, to have trans-shipment terminals. Through these, LP Gas will be imported using special tankships which may transport different LP Gas products. In these ships, LP Gas may be transported under pressure, at ambient temperature, or semi / fully "refrigerated", i.e. at low temperature and reduced pressure. The choice between these modes will be determined by economic considerations which will themselves be strongly influenced by the scale of operation.

5.1.2 A national market may be served by one or more terminals capable of receiving very large ships with part of the cargo for local use and part being trans-shipped to smaller import terminals, by coastal tanker or barge.

5.1.3 When transported in large ships, LP Gas is normally refrigerated with Butane and Propane stored in different cargo tanks. The inland market will require, and the coastal shipping will transport, LP Gas under pressure, i.e. at, or close to, ambient temperature. The market may require Butane, Propane or an LP Gas mixture. This will prompt consideration of whether the large receiving terminal storage should be refrigerated and, if not, how the incoming LP Gas should be brought to ambient temperature. These questions all have major safety implications both for the initial design and for subsequent operations.

5.1.4 An LP Gas trans-shipment terminal may be developed as an independent, "stand-alone" installation with its own ship-handling facilities. More often, an LP Gas terminal becomes an additional activity sharing nearby facilities with others.

5.1.5 The planning of an LP Gas trans-shipment terminal should include major hazard and environmental impact studies for both the onshore and offshore aspects, using internationally-accepted standards and criteria. The hazard study should take account not only of any compounding of risk associated with neighbouring industrial activities but also of the potential benefits from existing safety / security arrangements, including mutual assistance as part of emergency response programmes.

5.2 - Refrigerated / Pressure Shipping and Storage

5.2.1 The choice between shipping and storing LP Gas at ambient or reduced temperature and pressure is largely a matter of logistics and economics. There are costs associated with achieving and maintaining low temperatures but, under certain conditions, the unit costs of a refrigerated LP Gas containment system will be less than containment at ambient temperature and pressure. Control is essential for safety - whatever the choice of storage - and the cost of safety systems at such terminals will be significant.

5.2.2 The design and engineering of an LP Gas trans-shipment terminal should be in accordance with a reputable standard enjoying international recognition. Volume 1 of The Model Code of Safe Practice No. 9, Liquefied Petroleum Gas by the Institute of Petroleum deals with large bulk storage, both refrigerated and ambient temperature / pressure.

5.2.3 Each terminal will have its own special features and requirements. However, the terminal operations should adopt the safety principles and procedures developed and refined over the years. These can be found in such publications as:

- *Safe Transport, Handling and Storage of Dangerous Substances in Port Areas*, by The International Maritime Organisation (IMO);
- Guidance Notes GS 40 : *The Loading and Unloading of Bulk Flammable Liquids and Gases at Harbours and Inland Wateways*, by U.K. Health and Safety Executive;
- *Liquefied Gas Handling Principles on Ships and in Terminals*, by The Society of International Gas Tanker and Terminal Operators.

5.3 - Single / Multi-Product Terminal Operation

5.3.1 A single product terminal has the advantage of comparative simplicity, even if several grades of LP Gas are being handled there.

5.3.2 For the purposes of these Guidelines, a multi-product terminal is one in which LP Gas and another product, or products, are being handled. The multi-product aspect may be confined to a shared ship-handling facility or may also apply to the on-shore storage area.

5.3.3 The design, layout and operation of a multi-product terminal should be the subject of the most careful study and evaluation in respect of the compatability of products and of operations.

Inland Transportation

LP Gas is moved in bulk in the initial stages of inland transportation - by waterway, pipeline, rail or road.

Some consumers receive their LP Gas in bulk. Others receive their LP Gas in cylinders. Final delivery is usually by road.

Traffic risks vary from country to country and with the transportation mode. The LP Gas industry should be extra vigilant when the risk of a traffic accident is high.

Transport vehicles should be of a suitably high standard and operated by qualifed drivers.

References of Chapter 6 (see Appendix III)
G 3
T 18, 19, 20, 21, 22, 23, 33.

6.1 - General

6.1.1 Almost invariably, LP Gas is moved in bulk in the initial stages of inland transportation. For many applications, and especially for automotive and industrial use, LP Gas is transported in bulk throughout the distribution process. For others, LP Gas may have started the journey in bulk but is finally delivered, or collected, in a cylinder.

6.1.2 LP Gas may be transported by inland waterway, by pipeline, rail or road depending on the strengths and weaknesses of the national or local transport infrastructure, or depending on national regulations. There are hazards associated with all these modes of transportation but the risks will vary with local conditions. There will be times when the most economical method must be forgone in the interests of safety.

6.1.3 Tolerability of risk from traffic hazards varies from country to country. The LP Gas industry depends on transport to deliver its products and, therefore, should employ good safety practice in its inland transport operations. The industry should be extra vigilant where the external risk is known to be high.

6.2 - Primary Distribution in Bulk

6.2.1 Primary distribution refers to transportation in the first step of the distribution chain, i.e. from source of supply to major customers, bulk plants and cylinder filling plants. At this stage of distribution, the LP Gas is the property, and responsibility, of a primary marketer who will probably have entrusted the task of transportation to a specialist contractor.

6.2.2 While some primary distribution of LP Gas is by pipeline or barge, the principal transportation modes are rail and road. Whether conveyed in marketer-owned or contractors' vehicles, LP Gas transportation should be in accordance with national regulations and in accordance with good international practice. Comprehensive guidance is to be found in codes such as:

- The Agreement concerning the international carriage of dangerous goods by road (ADR);
- Regulations concerning the international carriage of dangerous goods by rail (RID).

6.2.3 In the absence of transportation contractors capable of providing the required standard of safety, the marketer should take direct charge and responsibility for primary distribution.

6.3 - Secondary Distribution in Bulk and Cylinders

6.3.1 Secondary distribution refers to the movement of LP Gas onward along the distribution chain from a bulk plant or cylinder filling plant. Ownership of the LP Gas may remain with the marketer or may be passed to others. A change of ownership will affect the exercise of safe practice.

6.3.2 Secondary distribution in bulk is further discussed in Chapter 9.

6.3.3 Secondary distribution in cylinders usually means transportation by road and exposure to the road traffic hazards. Drivers should be carefully selected and trained both in avoiding and in dealing with the consequences of accidents.

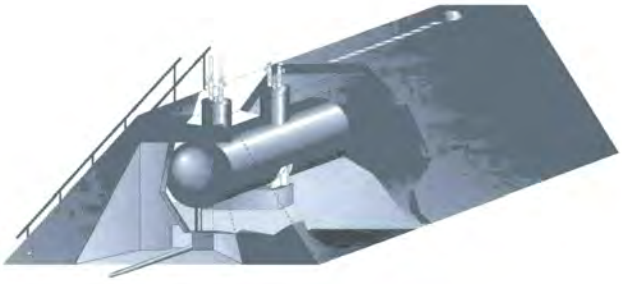
6.3.4 Trucks regularly employed in the transport of LP Gas should be designed, or adapted, to minimise the risks associated with the product and the mode of transportation.

6.3.5 LP Gas distribution trucks should display product identification plates and be equipped with suitable fire extinguishers.

6.3.6 Filled LP Gas cylinders which are intended to be utilised in the upright position should preferably be transported upright with the valves protected against any impact. Full and empty cylinders should, as far as is practical, be segregated on the truck.

6.3.7 Publications giving more detailed safety guidance for secondary distribution of LP Gas in cylinders are referred to in the Appendix III.

Bulk Storage and Handling



The location of storage should be considered in conjunction with the nature and scale of the LP Gas operations and of external risks.

Safety systems and procedures should prevent uncontrolled releases of LP Gas and the over-filling of storage tanks.

Passive safety features and fail-safe safety systems should be incorporated into bulk storage and handling facilities.

References of Chapter 7 (see Appendix III)
G 3, 4
T 15, 16, 17, 20, 25, 26, 34, 35, 36, 37.

7.1 - General

7.1.1 LP Gas may be stored on a large scale at an import or trans-shipment terminal, on an intermediate scale at depots, cylinder filling plants and large industrial consumers, or on a small scale at a household installation. The largest LP Gas terminals may have storage in excess of 100,000 tonnes.

7.1.2 In this section of the Guidelines our principal focus is on large and intermediate storage forming part of the distribution infrastructure. Small-scale bulk storage is discussed further in Chapter 9 of these Guidelines.

7.1.3 From a safety standpoint, LP Gas storage should be considered in conjunction with the nature and scale of the associated, on-site LP Gas handling operations. There are well-established standards and codes which, effectively employed, will substantially reduce both hazard and risk. These include :

- NFPA 58 - *Liquefied Petroleum Gas Code*, by the National Fire Protection Association (US);
- HSG 34 - *The Storage of LP Gas at Fixed Installations*, by the Health and Safety Executive (UK);
- Regulations for LP Gas service stations and road tank trucks in the Netherlands (for the special needs of the automotive sector).

7.1.4 A fire or explosion involving LP Gas in bulk storage is potentially a major incident and likely to have an impact beyond the operator's boundary fence. The development and operation of such facilities should be subject to consultation at official and community level. If national regulations stipulate licensing, the criteria should be risk-based.

7.2 Single / Multi-Grade Operation

7.2.1 Some markets work with a single grade of LP Gas and, therefore, have a simple system for product storage and handling. More often, commercial grade Butane, Propane and LP Gas mixtures are stored and handled separately. Some marketers may offer high-purity, chemical grade or de-odorised LP Gas requiring dedicated storage and handling systems.

7.2.2 For safety, the important considerations are that :

- stored LP Gas does not develop a vapour pressure in excess of the permitted maximum for any part of its containment system;
- nobody depends on the characteristic, unpleasant smell of stenched product to warn of the presence of odour-free LP Gas;

7.2.3 Multi-grade facilities should be equipped with the physical means of segregating the various grades of LP Gas and should have procedures to check and validate the effectiveness of such segregation.

7.2.4 Each LP Gas storage tank should be suitable for the grade of product to be stored in it at the expected temperature range and developing the highest vapour pressure.

7.3 - Technical Options - Types of Storage

7.3.1 LP Gas is stored in bulk in :

- salt domes, tunnels or caverns;
- cylindrical or spherical steel tanks which may be above-ground, underground or mounded.

The scale, location and method of operation of the storage facility will influence the choice from among these options. Environmental and safety issues must always be given due consideration.

7.3.2 Salt domes, tunnels and caverns are typically created deep underground and are most economical for large-scale pressure storage. However, they can only be realised if the on-site geological and geophysical conditions are favourable. Steel tanks are preferred for large-scale refrigerated storage.

7.3.3 With growing appreciation of the attractions of passive safety - and confidence in modern corrosion protection technology - more intermediate and small-scale LP Gas storage is being mounded or installed underground. In some countries these may be the only permitted technical options for intermediate-scale storage.

7.3.4 The reduced risk with mounded and underground LP Gas storage is reflected in a relaxation of safety / separation distances in certain standards. The distances given in such reputable publications as NFPA 58 and HSG 34 are empirical, not scientific. A scientific approach, based on experimental tests and practical experience and using quantified risk assessment techniques, is being developed within the LP Gas industry.

7.4 - Technical Options - Product Transfer

7.4.1 LP Gas transfer is potentially hazardous - an activity where things can and sometimes do go wrong because of equipment or procedural failure.

7.4.2 Pipelines for the transfer of refrigerated LP Gas are insulated to protect the product against unwanted heat gain. Product temperatures should not be below the design and material specifications. When refrigerated LP Gas is to be transferred to non-refrigerated storage, an inline product heater may be employed. At coastal locations in warm or temperate climates, seawater may be used as the heating medium.

7.4.3 The most common bulk transfers are between depot tanks and rail tank cars /road tankers or, in the case of automotive LP Gas, between station and vehicle tanks. Road tankers and rail tank cars may be loaded by weight or by volume, singly or in groups. All such transfers must be monitored to ensure that maximum fill limits are not exceeded. It should be constantly borne in mind that cold LP Gas will expand as its temperature rises.

7.4.4 Articulated loading arms are preferred for in-depot transfers but flexible hoses are currently the only practical option for bulk delivery to consumers and for automotive refuelling.

7.5 - Safety Systems for Operation

7.5.1 The first rule of safety is to avoid any uncontrolled leakage of LP Gas. All systems should be designed with this prime objective in mind.

7.5.2 The traditional approach to safety is based on generous use of space and of water deluge systems for emergency response. Increasingly, this approach is giving way to the concept of passive safety and to fail-safe valving and control systems. The passive safety concept is evident in mounded and underground tanks. A modern valve control system will be capable of automatic and / or remote operation. It will ensure that main valves are closed unless they are required to be open and only while that requirement lasts.

7.5.3 High and low-level alarms fitted to plant storage tanks can be a useful defence against overfilling but they should not be seen as an alternative to proper supervision.

7.5.4 With their emphasis on safety management systems, risk assessment, training and periodic inspections, regulations derived from the European Directive 96/82/EEC (Seveso II Directive) can be a valuable part of a plant safety programme.

7.5.5 Many plant incidents take place outside normal working hours, often during maintenance operations. After hours security and supervision of maintenance work are crucial for safety.

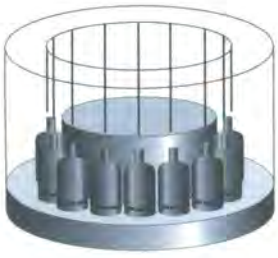
7.5.6 Static electricity discharge is a cause for concern and so steel structures and pipework should be earthed. Road tankers should be earthed before LP Gas transfers commence.

7.5.7 Road tankers admitted to the plant should be equipped to the standard specified in national regulations or in a reputable code, such as ADR. Vehicles should be immobilised during transfer operations and equipped to prevent untimely movement. Load / unloading bays should be protected against impact. Both company-owned and contractors' vehicles should comply.

7.5.8 Fire-resistant coatings can provide a useful means of improving safety in both fixed tanks and transport tanks. They have the advantage that they can be applied to existing tanks to augment an existing safety system. However, the selection and application of such coatings should be entrusted to specialists.

7.5.9 Closable pipelines and storage should be equipped with safety valves to protect against possible damage as liquid LP Gas expands.

Cylinder Filling and Handling



Cylinders should be filled with the intended product - Butane, Propane or specific LP Gas mixtures – and should never be over -filled.

Cylinders should be checked before and after filling to ensure that they are fit to fill, have been correctly filled and will be trouble-free in service.

A mis-handled cylinder can cause injury or result in an uncontrolled release of LP Gas. Handling of LP Gas cylinders should, as far as practical, be mechanised.

References of Chapter 8 (see Appendix III)
G 3, 4
T 27, 28, 29, 30, 31, 32, 33, 34, 36.

8.1 - General

8.1.1 Cylinder filling plants vary in scale and sophistication from simple, single-station operations filling small numbers of cylinders on demand to high-technology plants serving hundreds of thousands of consumers.

8.1.2 LP Gas is sold by weight in cylinders and, too often, accuracy of filling means "not being underweight" to both consumer and filler. It is not always appreciated that an overfilled cylinder, i.e. one which may become liquid-full, can be highly dangerous.

8.1.3 Ownership of cylinders can have an important bearing on safety. They should be manufactured and maintained in accordance with recognised technical standards. Non-compliant cylinders should not be re-filled although this can lead to difficulties when the consumer owns the cylinder and he may suspect a motive in a refusal to fill it. The consumer will have little appreciation of the safety checks which the professional re-filler carries out as a routine part of his work.

8.1.4 Cylinder maintenance and repair are potentially hazardous activities, and, when undertaken in a filling plant, can become disruptive of cylinder filling operations. Maintenance and repair should be carefully planned in order to avoid such disruption.

8.1.5 Filling plants handling more than one grade of LP Gas should be designed and equipped accordingly. They should have the physical and procedural controls to ensure that one is not mistaken for the other.

8.2 - Cylinder Filling and Checking

8.2.1 Cylinder filling operations should be carried out in accordance with a reputable technical standard or code such as, Code of Practice 12 - *Recommendations for Safe Filling of LP Gas Cylinders at Depots*, by the LP Gas Association, UK.

8.2.2 The initial check is to ensure that the cylinder is fit for refilling, i.e. that when filled it will not create a problem for either the refiller or the consumer. This initial check is also for compliance with any national or industry revalidation rules.

8.2.3 The cylinder valve is normally dual purpose in that it is used both for re-filling and to supply gas to the consumer. The condition and performance of the valve is crucial for safety.

8.2.4 National regulations may determine the permitted filling tolerances. While complying with these the refiller must ensure that he fills the correct grade of LP Gas and that he has not exceeded the maximum permitted fill volume for the cylinder, i.e. that there is no risk of the cylinder becoming liquid-full.

8.2.5 Post-filling checks are specified in the Code of Practice referred to in 8.2.1 above. The objective is to provide the consumer with a cylinder which has been correctly filled, will be trouble-free in use and meets all national or industry labelling requirements.

8.2.6 Post-fill procedures should include leak-testing, checkweighing and, in the absence of fixed protection (e.g. a shroud) the fitting of a suitable form of cylinder valve protection. Increasingly, LP Gas marketers are fixing a tamper-proof seal to the cylinder valve after re-filling.

8.2.7 Both full and empty LP Gas cylinders can cause serious injury during manual handling and, where possible, handling should be mechanised.

8.3 - Care and Maintenance of Cylinders

8.3.1 An LP Gas cylinder is a pressure vessel which may, during the process of distribution, be subjected to rough treatment. Nevertheless, its integrity is essential for safety and, therefore, it must be properly maintained.

8.3.2 Where the LP Gas marketer retains ownership of cylinders - and the empties are returned to him for refilling - the marketer is also responsible for care and maintenance.

8.3.3 When the consumer owns the cylinder he also assumes - probably unwittingly - responsibility for maintenance. In this case, compliance with cylinder requalification requirements can be very difficult. The cost of requalification (to be borne by the owner-consumer) and problems of access to requalification facilities are likely to be contributing factors. The owner-consumer system also carries the risk of a do-it-yourself approach to cylinder valve repair / replacement.

8.3.4 In the absence of national regulations, there are reputable codes which specify intervals for inspection and requalification. Cylinder filling codes, such as COP 12, include acceptance / rejection criteria for damaged cylinders. The LP Gas marketer filling the cylinder must be responsible for checking for compliance with these criteria.

8.4 - Technical Options for Cylinder Filling

8.4.1 Although the leading equipment manufacturers also offer volumetric filling machines, most LP Gas cylinders are filled by weight, i.e. by reference to individual tare weights and a specified fill, or weight, of LP Gas. At high volume, the challenge for the equipment manufacturer is to provide speed and accuracy for both filling and checking together with flexibility to deal with different types of cylinder and different grades of LP Gas. At low volume, accuracy of filling and checking are equally important for safety. Generally, a checkweigh scale is needed for "weights and measures" compliance with 100% checkweighing becoming the norm.

8.4.2 Essentially, the technical options for cylinder filling are:

- A small number of high volume plants;
- A larger number of low volume plants;
- High automation / few workers and vice-versa.

8.4.3 Filling large numbers of cylinders manually is heavy, monotonous work and the risk inherent in a labour-intensive plant should be evaluated against that of a well-managed, automated plant. Management of safety should always be appropriate to the number, size and type of plants.

8.4.4 Advances in electronics, in metering and in data management systems have moved the technology of cylinder filling forward and have helped to make LP Gas operations safer. However, any programme to automate should ensure that safety systems are updated as filling procedures change.

8.5 - Storage and Handling

8.5.1 LP Gas cylinders can cause serious injury during manual handling and, wherever possible, handling should be mechanised.

8.5.2 Conveyors and other parts of a mechanical handling system should be earthed to discharge static electricity.

8.5.3 Fork lift trucks are invaluable cylinder handling aids. They should be equipped with spark-supressing features and observe any hazardous zone restrictions within the filling plant or depot.

8.5.4 Training should be provided for those involved in cylinder handling in order to minimise the risk of injury to workers and of damage to the cylinders.

8.5.5 The storage of cylinders should be systematic with full and empty cylinders segregated and confined to designated areas. Specific guidance can be found in COP 7 - *Storage of Full and Empty LP Gas Cylinders and Cartridges,* by the LP Gas Association (U.K.).

8.5.6 Cylinders requiring maintenance, repair or fill correction should be dealt with urgently by trained workers, properly supervised. Such cylinders are potentially hazardous and a backlog should never be allowed to accumulate within the cylinder filling area.

8.6 - Safety Systems for Operation

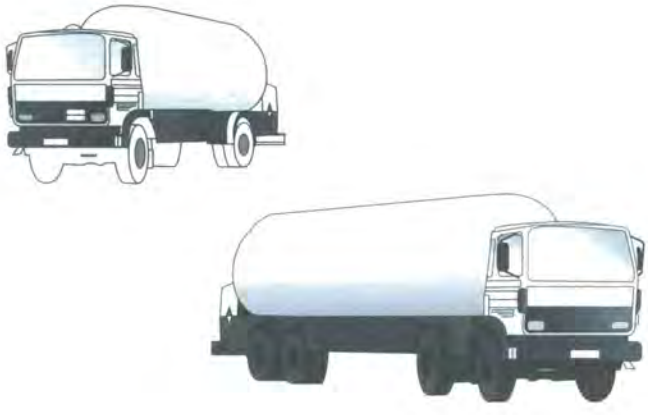
8.6.1 A cylinder filling plant has many potential trouble spots which, in a large plant, may be some distance apart. Plants should incorporate an emergency shutdown system to stop the flow of LP Gas, pumps and filling equipment. An alarm system capable of operation from key locations and of actuating emergency response measures is considered an essential part of the plant safety system.

8.6.2 Clear signage (including roadmarking) and effective gatehouse control over vehicle and individual access to the hazardous areas are also considered essential.

8.6.3 Many plant incidents take place outside normal working hours, often during maintenance operations. After-hours security and supervision of maintenance work are crucial for safety.

8.6.4 More detailed guidance of safety systems for operation can be found in COP 12.

Distribution in Bulk



Bulk LP Gas distribution requires equipment and skills which differ from those required for cylinder distribution.

The consumer's installation and the bulk delivery vehicle should be correctly designed, equipped and maintained.

The driver / operator should be properly trained and equipped to handle both normal operations and emergencies.

References of Chapter 9 (see Appendix III)
G 3
T 15, 16, 18, 19, 20, 21, 22, 23, 24, 35, 36, 37.

9.1 - General

9.1.1 In the LP Gas industry, "bulk distribution" generally refers to supply by road tanker into a fixed storage tank, or tanks. LP Gas is sometimes distributed in bulk, using demountable or containerised tanks, but this is an exception, not the rule. All accepted alternatives will be dealt with in these Guidelines.

9.1.2 Bulk distribution may be "full-load", where the customer has sufficient storage to accept the contents of the supplying road tanker, or "part-load", where the tanker's LP Gas cargo is shared among a number of customers. Full-load distribution may be by weight or by volume while part-load is by volume, measured by a tanker-mounted metering system. The system should include a temperature correction feature to take account of changes in volume arising from changes in LP Gas temperature.

9.1.3 From a safety standpoint, the key considerations are that LP Gas is transferred into the consumer's installation and that a release of product during transfer may involve both the delivery tanker and the fixed storage.

9.1.4 Bulk distribution is popular with consumers as it often means a higher level of convenience than cylinders. Sometimes, because of the quantity involved, it is the only practical method of supply.

9.1.5 Bulk distribution - and the bulk installation which is a necessary part of the system - call for technical, operational and safety expertise which may not be available in a cylinder-only LP Gas market.

9.1.6 Bulk distribution may have the effect of reducing the number of trucks employed in transporting LP Gas (when compared with cylinders), thus reducing the traffic accident hazard. On the other hand, the amount of LP Gas being carried on each truck will be greater with potentially more serious consequences in the event of a major traffic accident. Technical standards for tanker construction, on-board safety systems and driver skills should be of a suitably high order.

9.2 - Technical Options

9.2.1 The technical options for bulk distribution of LP Gas are:

- Demountable or containerised tanks;
- Road tankers without LP Gas transfer equipment;
- Road tankers with on-board LP Gas transfer equipment.

9.2.2 Demountable tanks may be relatively small capacity (i.e. 1 tonne and upwards) and are sometimes used to distribute chemical grade LP Gas or where physical access to the consumer is difficult or where the quantity for distribution does not justify the expense of a road tanker. Containerised tanks are mounted within a standard ISO container frame. Both demountable and containerised tanks require specialised handling equipment and are probably at highest risk during handling operations.

9.2.3 Road tankers without LP Gas transfer equipment are generally used for full-load deliveries and are unloaded using a fixed pump or compressor at the receiving location. These are rated as low-risk operations because transfers are usually made in controlled environments.

9.2.4 Road tankers with transfer equipment - usually a pump driven by the truck's engine and an in-line flow meter - are an essential part of bulk LP Gas distribution. Making frequent deliveries through a flexible hose, they require more elaborate safety equipment. A comprehensive hose inspection / renewal programme should be implemented. One-man operation is normal but only by a properly trained driver-operator.

9.3 - Bulk Supply and Delivery

9.3.1 Tanks used on LP Gas road tankers are specially designed and constructed for this duty, as are skid-mounted and containerised tanks. A tank intended for static storage should not be used for deliveries.

9.3.2 Tank nozzles and valves are fitted internally, recessed into the tank shell or positioned so as to minimise the risk of impact damage and to prevent unauthorised access.

9.3.3 Road tankers may be loaded by volume or by weight but should always retain a safety margin, or ullage, to protect against the tank becoming liquid-full of LP Gas.

9.3.4 The time of delivery, i.e. connection, pumping and disconnection, is normally the time of highest risk requiring the full attention of the driver - operator as well as due care on the part of the consumer.

9.4 - Safety Systems for Operation

9.4.1 The bulk distribution system requires the driver-operator to spend some time at the tank and some at his tanker during delivery. Ideally, there should be a clear line of sight and unimpeded access between them. Where sight or access are impeded, the driver-operator should be able to shut off the road tanker's engine and close the liquid outlet valve while stationed at the consumer's storage tank and monitoring the filling process.

9.4.2 The vehicle should be equipped with a number of externally-mounted shutdown devices to enable the driver to stop pumping operations quickly and to secure the vehicle in an emergency. It is normal to fit a remote shutdown switch or button on the end of the delivery hose so that the driver can halt pumping without the need to return to the vehicle. Sometimes, a "dead man's handle" is incorporated so that pumping can continue only in response to a positive action of the driver. In some areas a radio frequency device with a transmitter is used to remotely shut off the engine and the liquid outlet of the road tanker.

9.4.3 The vehicle should be protected against moving, or being driven away, with the hose connected to the stationary tank. Standard systems include wheel chocks, alarms in the driver's cab and pneumatic devices to immobilise the vehicle while the hose is unhoused. The driver-operator should remain in attendance (see paragraph 9.4.1) while transfer hoses are attached and should switch off the truck engine when attaching and detaching hoses.

9.4.4 The vehicle must be "earthed" before the filling / unloading hose is connected. Fire extinguishers should be carried on the vehicle and kept ready for use during delivery operations.

9.4.5 The bulk delivery driver should be carefully selected, properly trained and accorded status in accordance with his responsibilities.

Consumer Installation and Usage

Technical and safety standards should be established for LP Gas appliances and for consumer installations.

Only qualified installers and servicemen should be permitted to undertake LP Gas installation work.

Consumers should be informed about potential hazards in using LP Gas and about the safety features of appliances and their installation.

Consumers should exercise due care in the use of LP Gas.

Consumers should insist that LP Gas installers and servicemen are properly qualified for such work.

References of Chapter 10 (see Appendix III)
T 15, 20, 36, 37, 38, 39.

10.1 - General

10.1.1 The versatility of LP Gas and its range of applications are reflected in the diversity of installation. These include leisure or household applications employing less than a kilogramme of LP Gas to industrial installations supported by hundreds of tonnes of LP Gas in on-site storage.

10.1.2 For the purposes of these Guidelines, the installation comprises an LP Gas supply - cylinder or tank - connected to one or more appliances, or to a dispenser. The connection may be direct from cylinder to appliance, through a flexible hose or through hundreds of metres of pipework to a multiplicity of appliances. Automotive LP Gas falls within this overall classification but is something of a special case.

10.1.3 The LP Gas supplier may also be the supplier and / or installer of the appliance. More often, however, these activities are separate and the LP Gas supplier may not know exactly where and how the product is being used.

10.1.4 Consumer safety depends on the performance of the installer, as well as the standard achieved by the supplier of the LP Gas and of the appliance. It also requires an appreciation on the part of the consumer of the importance of such performance - and a willingness to pay for it.

10.1.5 Most accidents - and fatalities - occur at, or near, the point of use. Prompted by this, authorities are increasingly regulating the activities of installers and setting standards for installations.

10.2 - Role and Duty of the Installer

10.2.1 It is the role of the installer to bring together the LP Gas supply and the LP Gas-consuming appliance and, having connected them, to ensure that the system is working correctly.

10.2.2 The role of the installer is crucial for LP Gas safety and, therefore, he should have reached a specified level of proficiency, i.e. be qualified by training and experience.

10.2.3 The installer has a duty to ensure that his work conforms to any statutory or code requirements and to draw attention to any defect in the LP Gas supply or in the appliance which he is instructed to install.

10.2.4 The installer should instruct the consumer in the correct use of the LP Gas installation, in its safety features - including ventilation - in its servicing / maintenance needs and in the action to be taken by the consumer in the event of difficulty.

10.2.5 Recognising the importance of good installation practice, some national authorities regulate the activities of installers. An example may be seen in the Gas Safety (Installation and Use) Regulations of the UK.

10.3 - Appliance Installation, Inspection, Servicing

10.3.1 The LP Gas supplier and the appliance manufacturer may not know where the appliance is installed but they nevertheless have a role in its safety. They should exercise this role by promoting good installation standards and insisting on qualified installers.

10.3.2 A formal system of information exchange between LP Gas marketers, appliance manufacturers and installers can be an highly effective safety measure.

10.3.3 LP Gas deliverymen should be instructed to inspect the external installation at each visit to their consumers and to report any defects. Marketers must be prepared to follow up such reports promptly.

10.3.4 Delivery men responding to "out of gas" calls should additionally check the operation of controls and any pilot lights in the internal installation and, if necessary, attach a written warning not to turn on the LP Gas supply until a qualified person has tested the system for safety.

10.3.5 Servicing is especially important for appliances which are used seasonally or which may have remained unused for a long time. LP Gas marketers should actively promote an internal inspection and servicing programme for their consumers, in association with qualified installers. It may be counter-productive to announce a programme unless it is adequately resourced and managed.

10.3.6 Builders and consumers should be made aware of the need to have LP Gas installations inspected when carrying out construction or alteration work which could affect safe operation, paying particular attention to ventilation and the removal of the products of combustion.

10.3.7 Inspectors should pay special attention to the number of spare LP Gas cylinders at consumers' installations and the storage arrangements for them. Spare cylinders - full or empty - are potentially hazardous and their numbers should be kept to the minimum required for continuity of supply.

10.3.8 Operating, service and safety instruction literature should be kept up-to-date and widely disseminated.

10.4 - Domestic and Commercial Applications

10.4.1 The diversity of LP Gas applications means that, sometimes, LP Gas is only one of several hazardous substances present. In others, such as aerosols and refrigerant applications, the consumer may be unaware of the presence of LP Gas.

10.4.2 The use of LP Gas cylinders indoors is normal, accepted practice in some countries. LP Gas safety programmes should emphasise the need for care - especially when exchanging LP Gas cylinders indoors.

10.4.3 Water heaters are frequently involved in domestic incidents with LP Gas, notably carbon monoxide poisoning. Because they are high-output appliances, and are often installed in small bathrooms, adequate ventilation to remove combustion products is especially important for consumer safety. Flues should be checked regularly for obstructions, e.g. snow and nests.

10.4.4 LP Gas is an indispensible part of commercial cooking but there is a tendency to place cylinders in out-of-the-way places where they may constitute an unseen hazard. Cylinders should never be installed or stored in basements, at exits, or in congested or poorly-ventilated places.

10.4.5 An efficient delivery service can contribute to safety by removing the need to hoard cylinders in unsafe conditions.

10.4.6 Providing the correct grade of LP Gas and of equipment can be an effective safety measure by deterring dangerous practices. A high-offtake application which may be difficult to fuel using Butane is more likely to be trouble-free with Propane.

10.5 - Automotive

10.5.1 The automotive application, i.e. the use of LP Gas as a transportation fuel, is capable of very rapid growth once the conditions are right.

10.5.2 Specific safety measures apply to automotive LP Gas equipment. For example, the UN/ECE Regulation 67 defines the minimum requirements for automotive LP Gas equipment fitted on vehicles. It is extremely hazardous to operate a gasoline engine using a household LP Gas cylinder and hose ; LP Gas should never be used in this way on a vehicle.

10.5.3 The opening of an automotive LP Gas market should be accompanied by a determination to set and enforce appropriate safety standards, i.e. to ensure that a motorist is at no greater risk using LP Gas than when using gasoline. For example, CEN, the European Standards Organisation, considered the minimum safety requirements for LP Gas vehicles, the equipment, components and their installation, as well as the distribution of automotive LP Gas.

10.5.4 Some countries insist on separate re-fuelling stations for LP Gas while others allow LP Gas dispensers on gasoline forecourts. Good equipment and procedures will ensure safety for both systems.

10.5.5 More detailed guidance can be found in publications such as the Regulations for LP Gas service stations and road tank trucks in the Netherlands and draft CEN standards on automotive LP Gas re-fuelling stations.

10.6 - Consumer Safety Awareness

10.6.1 LP Gas is sold on the basis of benefits, i.e. that it is better than competing fuels for certain applications. It is also hazardous and most LP Gas-related incidents occur at, or close to, the point of use. In his efforts to win and retain consumers, the marketer seeks to create safety awareness without undermining his product.

10.6.2 The LP Gas industry must address the safety issue directly and enlist the support of national regulatory authorities and consumer organisations to create safety awareness. Together, they should publicise the steps which consumers should take - and those to avoid - in the interest of safety, e.g. by providing Material / Safety Data Sheets.

10.6.3 As consumer safety depends on the appliance and the installation as well as the LP Gas supply, authorities should set standards for all three components and make consumers aware of them. An example is the CE mark which is mandatory on appliances sold in EU member states.

10.6.4 Cylinder labels, mail shots, point-of-sale notices can all be effective in raising consumer safety awareness. To maintain awareness, messages and presentations should be refreshed from time to time. Brief, timely campaigns are especially useful for seasonal users.

10.6.5 The use of detectors and alarms should not be discouraged but neither should consumers become over-dependent on them. Such devices can be particularly useful in warning against a build-up of CO and for the safety of consumers with an impaired sense of smell.

Managing Safety

In any organisation, the most senior management should accept responsibility for safety and should ensure that the resources are available for the safety management programme.

Safety management should be knowledge - based and should operate within a formal structure of policy and action plans.

Safety programmes should be regularly up-dated on the basis of systematic reviews and advances in technology.

Accident experience can be instructive and should be shared for the benefit of all.

References of Chapter 11 (see Appendix III)
G 1, 3, 4
T 8, 36, 40

11.1 - General

11.1.1 LP Gas is potentially hazardous from the time of production until it has been used and the products of combustion have been safely disposed of. The management of safety is correspondingly wide-ranging.

11.1.2 Management of the hazards associated with LP Gas starts with an understanding of the product and with the exercise of control under all conditions. In the event of a fire affecting LP Gas in storage, particular care is required to prevent the development of conditions which could lead to a BLEVE. If, under abnormal conditions, control is lost then the management task is to regain it with the minimum loss. LP Gas in isolation is not hazardous but even a small leakage must be dealt with immediately.

11.1.3 The safety management programme should also address hazards incidental to the manner in which LP Gas is distributed and used.

11.1.4 At the beginning of the distribution chain LP Gas is usually stored and handled in sufficient quantity to constitute a major industrial hazard and is regulated accordingly. Further along the distribution chain LP Gas will pass through less skilled hands but the safety management task remains.

11.1.5 At the point of use LP Gas may be a culprit or an innocent party to an incident arising from deliberate mis-use of the product or through a faulty appliance or installation. Such exposures further complicate the management task.

11.2 - Management Commitment and Leadership

11.2.1 Effective safety management requires a clear commitment from proprietors, and their appointed top managers, to put safety among their key concerns and priorities.

11.2.2 Top management should demonstrate that commitment through unequivocal leadership, sanctioning and implementing the actions required for a safety programme appropriate to the companies role in the LP Gas industry.

11.3 - Policy, Objectives, Action Plans, Resources

11.3.1 Participants in the LP Gas industry should publish a safety policy for their companies, explaining its objectives and action plans to their employees and business partners. The manner and format in which safety policy is promulgated will vary from company to company and may be determined, in part, by national regulations.

11.3.2 Larger organisations should introduce clear, written definitions of the role of managers at all levels. Individual responsibilities and objectives should be specified in respect of the safety programme.

11.3.3 Safety policy lacks credibility without specific action plans and the resources required for implementation. Where licensing of LP Gas operations is required, the responsible authorities should give due consideration to this.

11.4 - Laws, Standards and Codes

11.4.1 Laws provide the legal basis for regulations intended to safeguard the safety of the general public and consumers. There may be a law specifically enacted for LP Gas but the product is sometimes brought within the scope of broader legislation.

11.4.2 The public interest requires a measure of safety regulation over hazardous substances, including LP Gas. Participants in the LP Gas industry should co-operate with government authorities by making their expertise available to ensure that safety regulations are soundly-based.

11.4.3 LP Gas standards and codes embody the technical expertise of a mature industry which constantly seeks to improve its safety image and performance. There are many such standards and codes referred to in these Guidelines and / or listed in Appendix III. Consideration should be given to adopting standards and codes which have achieved international recognition rather than undertake the necessarily laborious work of preparing, or up-dating, national standards.

11.5 - Hazard Identification, Evaluation, Quantification, Mitigation

11.5.1 We recognise that, in a modern industrial society, certain hazards are present and unavoidable as part of our basic wants and needs. This has prompted ideas of hazard evaluation and the tolerability of risk.

11.5.2 The LP Gas industry should take the initiative in LP Gas-related hazard identification, evaluation and quantification, using its expertise to encourage a science-based approach by the authorities responsible for safety regulation.

11.5.3 National authorities and the LP Gas industry should maintain a dialogue about LP Gas-related hazards and technical advances which might be employed in mitigating risks. Where possible, both parties should engage in international, as well as national, dialogue for this purpose.

11.5.4 Contacts between the LP Gas industry and the authorities should not be confined to times of difficulty. The immediate aftermath of some tragic event is probably not the best time to introduce, or to amend, safety regulations.

11.5.5 Leading participants in the LP Gas industry - marketers, equipment and appliance manufacturers - work constantly and constructively on safety management issues through improvements in technical standards, safety features and procedures. Regulatory authorities should encourage and support hazard mitigation by excluding participants who are not prepared to be part of this process.

11.6 - Systematic Review, Corrective Action

11.6.1 Having published their safety policies and set their safety objectives, marketers should put in place a system of reviews to monitor progress towards achieving those objectives. The review should be seen as a high-level activity receiving top management's attention. Operating companies should develop and update a corrective action and safety improvement plan.

11.6.2 The review should monitor all points of the marketer's distribution chain and provide information feedback to appliance and equipment vendors and installers.

11.6.3 Where a licensing system operates, evidence of systematic safety review process should be a factor in the periodic re-licensing of LP Gas facilities.

11.6.4 There are often useful lessons to be learned from post-incident investigations and such experience should be shared.

Emergency Planning and Response

Planning for emergencies should be an integral part of a safety management programme.

Planning and response should encompass every stage of the distribution chain as well as LP Gas in storage and in use.

An emergency at an LP Gas plant may have an impact beyond its boundary fence and the APELL process should be employed for preparedness at local level.

References of Chapter 12 (see Appendix III)
G 1, 2, 5
T 7, 8, 40.

12.1 - General

12.1.1 Emergency planning and response is one component of an overall safety management programme. The concept and procedures have been integrated into regulations for the control of major industrial hazards, prompted by such initiatives as the Seveso Directive which specifys "planning for emergencies" as part of the safety management system.

12.1.2 In these Guidelines, we will discuss the emergency planning and response process for:

- LP Gas plants of a size to be classified as "major hazards"
- LP Gas in bulk transport.

12.2 - The APELL Process

12.2.1 APELL is the acronym for Awareness and Preparedness for Emergencies at Local Level, a process developed by the UNEP Industry and Environment Office in co-operation with industry and governments. With its emphasis on preparedness at local level, the APELL process recognises that the extent of an industrial accident's impact depends heavily on the immediate response to an emergency at the plant site and in its immediate vicinity.

12.2.2 Alongside this emphasis on local preparedness APELL recognises the role of government authorities in formulating regulations and in providing the resources which local communities need. APELL neither replaces nor interferes with established emergency response provisions but seeks to increase awareness of such provisions and activities.

12.2.3 At local level there are three very important partners who must be involved if APELL is to be successful - local authorities, industry and local community / interest groups.

12.2.4 APELL acknowledges the need and the right of the local community to be informed about and to participate at all times in response planning for hazardous installations.

12.2.5 Details of the APELL process can be found in the publication "*APELL - Awareness and Preparedness for Emergencies at Local Level : A Process for Response to Technological Accidents*", published by the United Nations Environment Programme, Industry and Environment.

12.3 - Emergency Plan, Procedures

12.3.1 Expert hazard evaluation and quantification should form the basis of the emergency plan by:

- Identifying the on-site and off-site hazards
- Quantifying the on-site and off-site impact of credible accident scenarios.

12.3.2 Whether required to do so by regulation, or not, the site owner or project promoter should provide the initial hazard evaluation and quantification. He should share this hazard information with the partners described in the APELL process and be prepared to provide independent verification, if required.

12.3.3 The development of the emergency response plan should conform to any national or local regulatory requirements and, ideally, the procedures specified in the APELL process.

12.3.4 The emergency plan should provide for an escalating sequence of events and emergency procedures should be tiered accordingly.

12.3.5 Pipeline and rail operators will have emergency response procedures for the various hazardous product transported by them. LP Gas marketers and suppliers using pipeline and rail transport should ensure that the operators fully understand the emergency procedures for the products being carried and that transport vehicles display the appropriate product identification labels to warn and assist emergency response teams.

12.4 - Fire-fighting Principles, Procedures

12.4.1 The most effective way to fight an LP Gas fire is to shut off the LP Gas supply. If this cannot be done, it may be safer to allow the fire to burn itself out, i.e. to burn until the LP Gas supply to it has been exhausted, unless the continuing fire will result in an escalation of the emergency.

12.4.2 Dry powder or carbon dioxide fire extinguishers are effective against LP Gas fires.

12.4.3 Water is effective in cooling LP Gas vessels during a fire and in helping to keep the temperature of tanks, and their contents, below critical levels. Water spray can be useful in protecting fire-fighters attempting to close LP Gas supply valves in heat-effected areas and in dispersing LP Gas vapour.

12.4.4 Emergency response teams drawn from the plant staff should represent the first line of defence and should be trained for quick, decisive action to contain emergencies before they develop.

12.4.5 Emergency response to a fire on, or close enough to threaten, an LP Gas road tanker depends critically on the driver-operator and, therefore, the quality of his equipment - and his training in its use - are crucial to recovering control.

12.5 - Internal, External Responses

12.5.1 Most in-plant emergencies begin in a small way or as a result of failure to deal promptly and effectively with a minor incident. Owners and managers should recognise the value of rapid response by trained teams confident in their ability to deal with emergencies. Good equipment, a team spirit and regular training are essential for the commitment and confidence which ensures an effective internal response.

12.5.2 External response may be from local authority emergency services or from a mutual assistance group set up to respond to emergencies.

12.5.3 The effectiveness of both internal and external response depends initially on the seriousness of the event and then on resources, preparedness and timing. Fire drills and rehearsals for emergencies are an essential part of safety management and time should be made available for them. External response will be most effective when the team is totally familiar with the plant, its hazards and its defences.

12.5.4 Internal and external communications are important factors in determining the effectiveness of emergency response. The slightest delay in reacting to an emergency can make the difference between success and failure. No one should be criticised for over-reacting to an emergency.

12.6 - Investigation, Corrective Action, Follow-up

12.6.1 The purpose of post-incident investigation is to determine the causes - both immediate and underlying - so that lessons can be learned and corrective action taken. The investigating team should include an independent expert and should report to the owners, or to top management. The licensing authority may wish to participate, or to make an independent investigation.

12.6.2 An investigation may disclose the need for corrective action in respect of plant layout, equipment, systems, procedures or personnel. While the team should guard against developing an unrealistic "wish list", top management should be prepared to sanction their recommendations.

12.6.3 Top management should be prepared to discipline anyone who causes, or contributes to, an incident by disregarding safety rules and procedures. They should also recognise those who respond well in an emergency.

12.6.4 Follow-up should include information feedback to the APELL partners. If relevant information has to be witheld, or delayed, for legal or other good reason, this should be made clear to the partners.

12.6.5 If equipment or system defects contributed to an incident, then equipment suppliers, installers and other plants known to be similarly equipped should be alerted.

12.6.6 Authorities responsible for re-licensing should pay particular attention to any LP Gas facility where a reportable incident has occurred.

12.6.7 Following a serious incident, plant management should set about re-building relationships with workers and the community and recognise that this may take time.

Appendix I : Product Classification and Labelling

Hazard Warning Notices and Signs (UN)

Depending on the mixture, there are three UN classification numbers to be considered for LP Gas:

Butane or Butane mixtures – UN 1011

Propane or Propane mixtures – UN 1978

Or a common classification:

Petroleum Gas, Liquefied or Liquefied Petroleum Gas – UN 1075

All these gases fall under the Hazard Classification (Transport): Class 2 Division 1, indicated as 2.1 and have to be marked with the label 2.1. " Flammable Gas". The colour of the placard or label is red.

Appendix II : Glossary of Terms

Appliance	LP Gas consuming device e.g. a stove.
Bulk Supply	LP Gas supply to a consumer's tank.
CFCs	Chlorofluorocarbons.
Cylinder	Portable LP Gas container.
Tank	LP Gas container for bulk supply and transportation.
Cylinder Supply	LP Gas supply in cylinders.
Equipment	Device(s) connecting and/or controlling LP Gas supply from a tank/cylinder to an appliance.
Grade of LP Gas	Type of LP Gas, e.g. chemical, commercial, high purity. Proportion of Butane/Propane in LP Gas mixture, e.g. Butane rich mixture.
Hazard	A threat which could cause an accident. *(definition in APELL process)*
Risk	Probability of an accident occurring within a certain time, together with consequences for people, property and the environment. *(definition in APELL process)*
Passive Safety	Safety not dependent on active safety systems.
Requalification	Periodic inspection/testing to ensure that LP Gas cylinders and tanks remain fit for service.

Appendix III : List of References

General

G1 European Directive 96 / 82 / EC "Seveso II"

G2 IAEA - TECDOC - 727 : Manual for the classification and prioritisation of risks due to major accidents in process and related industries. International Atomic Energy Agency

G3 Product Dossier 92 / 102 : Liquefied Petroleum Gas. CONCAWE

G4 LPG Safety : Quantified Risk Assessment for LPG Operations. European LPG Association (AEGPL).

G5 APELL - Awareness and Preparedness for Emergencies at Local Level : A Process for Response to Technological Accidents. UNEP

Technical

T1 ISO 9162 : Standard for LPG. International Standards Organisation

T2 K 2644-87 : Standard for LPG. Japanese Institute of Standards

T3 Standard 2140 : Liquefied Petroleum Gas Specification and Test Methods. Gas Processors Association, US

T4 IS 4576 : Indian Standard for LPG

T5 BS 4250 : Standard for Commercial Butane and Propane. British Standards Institute, UK

T6 Standard D-1835, Specification for Liquefied Petroleum (LP) Gases. American Society for Testing and Materials, US

T7 Standard 54, National Fuel Gas Code. National Fire Protection Association, US

T8 Technical Report No. 3 : Storage of Hazardous Materials. UNEP IE / PAC

T9 Liquefied Gas Handling Principles on Ships and in Terminals. Society of International Gas Tanker and Terminal Operators

T10 Guidance Notes GS 40 : The Loading and Unloading of Bulk Flammable Liquids and Gases at Harbous and Inland Waterways. Health and Safety Executive, UK

T11 Safe Transport, Handling and Storage of Dangerous Substances in Port Areas. International Maritime Organisation

T12 Ship-to-Ship Transfer Guide (Liquefied Gases). ICS, OCIMF, SIGGTO

T13 Safety Guide for Terminals Handling Ships Carrying Liquefied Gases in Bulk. OCIMF

T14 NFPA 307 Standard for the Construction and Fire Protection of Marine Terminals, Piers and Wharves. National Fire Protection Association, US

T15 NFPA 58 Liquefied Petroleum Gas Code. National Fire Protection Association, US

T16 HSG 34 The Storage of LPG at Fixed Installations. Health and Safety Executive, UK

T17 Model Code of Safe Practice No. 9 - Liquefied Petroleum Gas Volume 1, Large Bulk Pressurised Storage and Refrigerated Storage. Institute of Petroleum, UK

T18 ADR - European Agreement concerning the International Transport of Dangerous Goods by Road.

T19 RID - Regulations concerning the International Transport of Dangerous Goods by Rail.

T20 Regulations for LPG service stations and road tank trucks in the Netherlands.

T21 Code of Federal Regulations - Transportation CFR 48. Department of Transportation, US

T22 Guide to Propane Transportation. National Propane Gas Association, US

T23 COP 2 Safe Handling and Transport in Bulk in Road Tankers and Tank Containers. LP Gas Association, UK

T24 AS 2809 : Australian Standard ; Road Tank Vehicles for Dangerous Goods Part 1 : General and Part 3 : LPG Road Tankers.

T25 ASME section VIII : Rules for the Construction of Pressure Vessels. American Society of Mechanical Engineers, US

T26 BS 5500 : Specification for Unfired Fusion Welded Pressure Vessels. British Standards Institute, UK

T27 Title 49 CFR Parts 171 - 190 Transportable LPG Cylinders. Department of Transportation, US

T28 EN 1142 : European Standard for LPG Cylinders. CEN

T29 BS 5045 : Welded Cylinders up to 130 Litres Water Capacity. British Standard Institute, UK

T30 Directive 84 / 527 / EC : Welded Unalloyed Steel Gas Cylinders.

T31 BS 5355 : Filling Ratios and Developed Pressures for Liquefiable and Permanent Gases. British Standards Institute, UK

T32 COP 7 : Storage of Full and Empty Cylinders, LP Gas Association UK

T33 COP 12 : Recommendations for Safe Filling of LPG Cylinders at Depots, LP Gas Association, UK

T34 49 CFR Parts 107-180 Hazardous Material Regulations, Requalification of DOT cylinders, Department of Transportation, US

T35 49 CFR Parts 350-399 Motor Carrier Safety Regulations, Department of Transportation, US

T36 LP Gas Safety Handbook. National Propane Gas Association, US

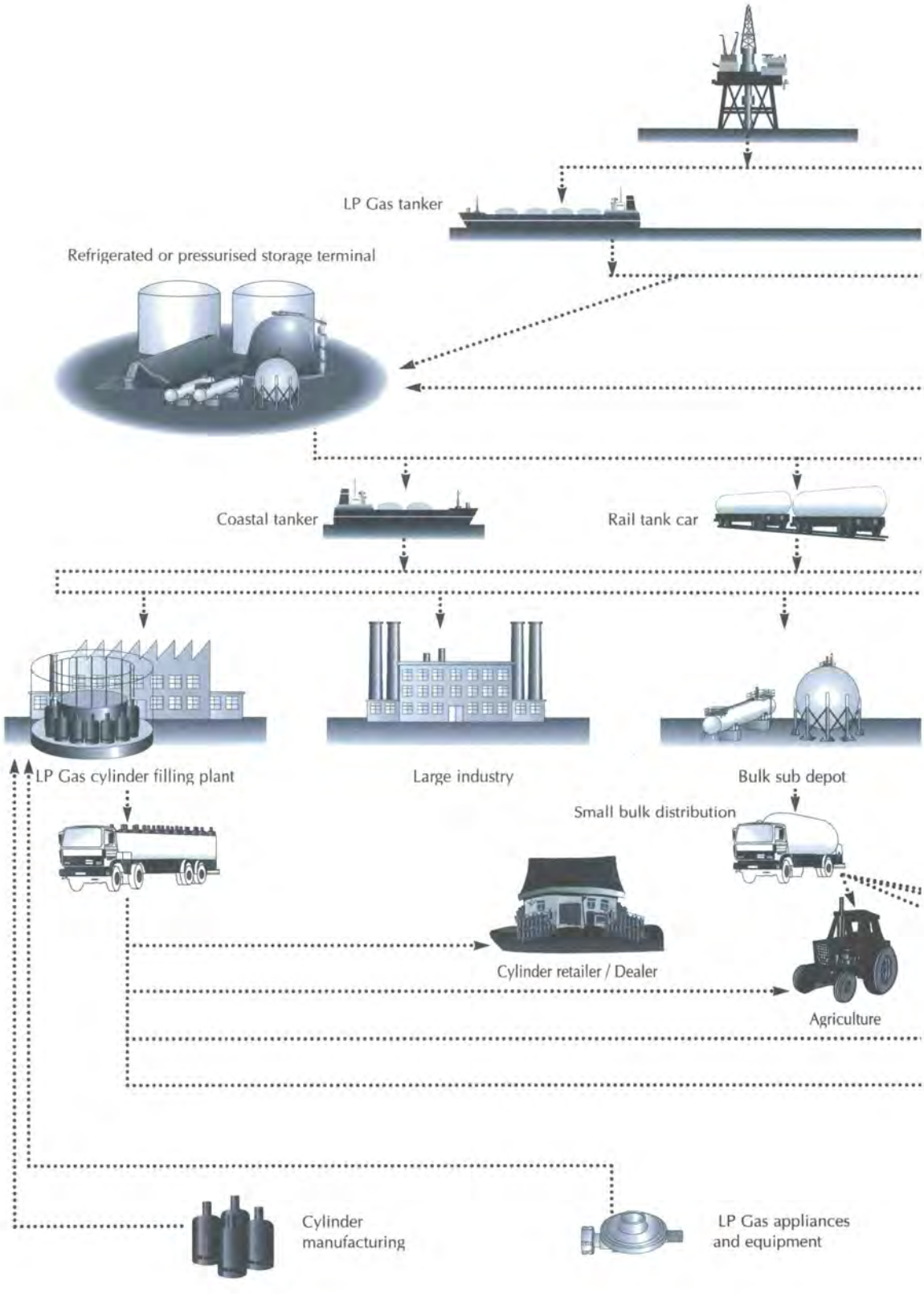
T37 COP 1 Installation and Maintenance of Bulk LPG Storage at Consumers' Premises. LP Gas Association, UK

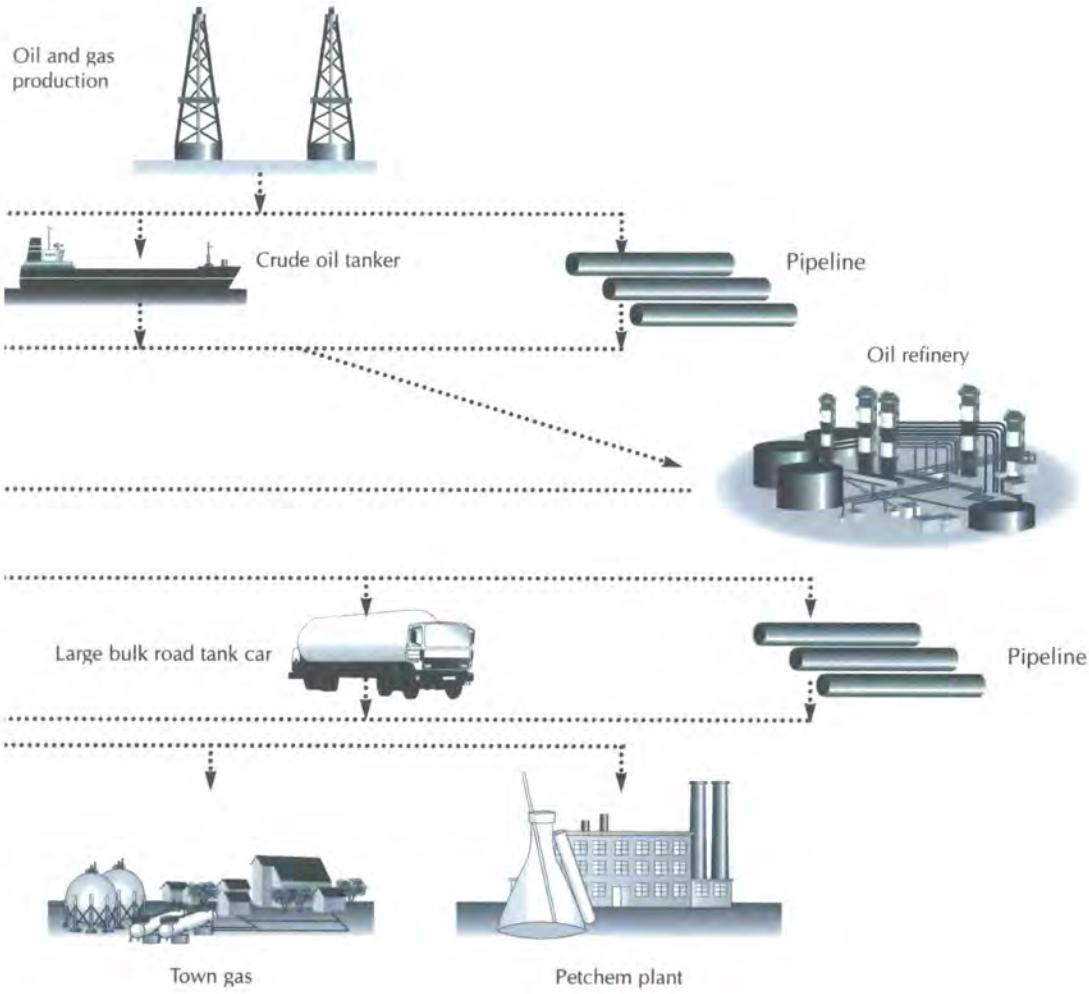
T38 The Gas Safety (Installation and Use) Regulations 1994. Health and Safety Executive, UK

T39 Aerosol Conversion Technology Handbook. UNEP IE

T40 Hazardous Substances Risk Assessment : A Mini-Guide for Municipalities and Industry. Major Industrial Accidents Council, Canada

Appendix IV : LP Gas Distribution Chain

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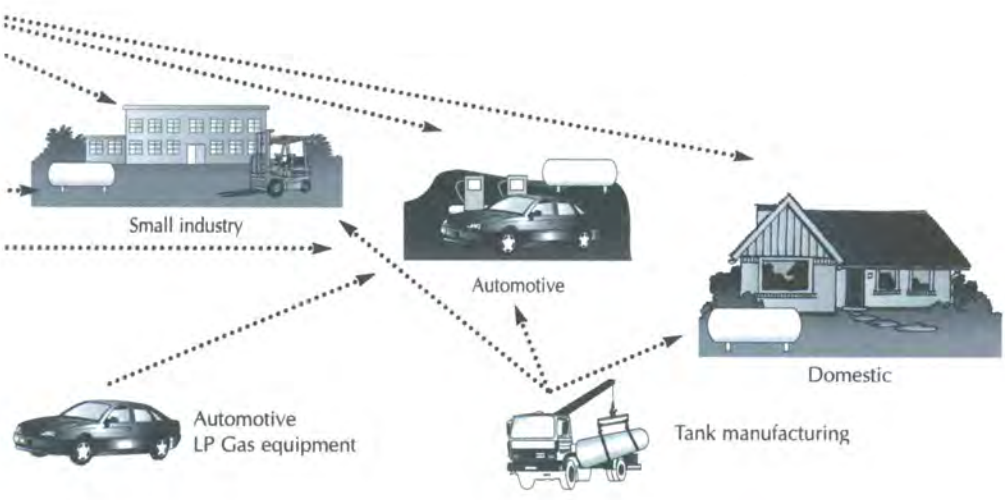
Crude oil tanker
Pipeline
Oil refinery
Large bulk road tank car
Pipeline
Town gas
Petchem plant


Small industry
Automotive
Domestic
Automotive
LP Gas equipment
Tank manufacturing

ABOUT UNEP
INDUSTRY AND ENVIRONMENT

The Industry and Environment centre was established by UNEP in 1975 to bring industry and government together to promote environmentally sound industrial development.

The mission of UNEP IE is to "encourage the development and implementation of industrial policies, strategies, technologies and management practices that contribute to sustainable development by making efficient use of natural resources as well as by reducing industrial pollution and risk".

The goals of UNEP IE are to :

- build consensus for preventive environmental protection through cleaner and safer industrial production and consumption;
- help formulate policies and strategies to achieve cleaner and safer production and consumption patterns, and facilitate their implementation;
- define and encourage the incorporation of environmental criteria in industrial production;
- stimulate the exchange of information on environmentally sound technologies and forms of industrial development.

To achieve these goals, UNEP IE has developed seven work programme areas: Cleaner Production, Safer Production (Awareness and Preparedness for Emergencies at the Local Level - APELL), Industrial Pollution Management, Environmental Technology Assessment (EnTA), Energy, Tourism, and Protection of the Ozone Layer (OzonAction).

UNEP IE provides access to information through two information exchange clearinghouses (ICPIC and OAIC), a query-response service, a series of technical publications, a quarterly journal, four newsletters, and through training workshops and seminars.

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- define and encourage the incorporation of environmental criteria in industrial production;
- stimulate the exchange of information on environmentally sound technologies and forms of industrial development.

To achieve these goals, UNEP IE has developed seven work programme areas: Cleaner Production, Safer Production (Awareness and Preparedness for Emergencies at the Local Level - APELL), Industrial Pollution Management, Environmental Technology Assessment (EnTA), Energy, Tourism, and Protection of the Ozone Layer (OzonAction).

UNEP IE provides access to information through two information exchange clearinghouses (ICPIC and OAIC), a query-response service, a series of technical publications, a quarterly journal, four newsletters, and through training workshops and seminars.

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