Code of Practice for

HONG KONG LPG INDUSTRY

MODULE 1

LPG Compounds and Cylinder Stores

ISSUE 3 MAY 2023

Gas Authority
EMSD

Code of Practice

for

Hong Kong LPG Industry

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PREFACE

This document is the first in a series of modules as Code of Practice for the LPG industry in Hong Kong Special Administrative Region (HKSAR). The other modules that have been published so far include the following topics:

- Underground LPG Pipework
- Handling and Transport of LPG in Bulk by Road
- Operating Procedures for Emergencies for LPG Compounds and Cylinder Stores
- LPG Cylinders

Module 1 lays down the recommended practices for LPG compounds and cylinder stores, including standby cylinder stores at consumer outlets, and for the associated equipment within the installations. This module shall be read in conjunction with the Gas Safety Ordinance (Cap. 51) and subsidiary regulations (See Appendix A for reference).

The basis of this document includes a number of codes of practice issued by Liquid Gas UK (formerly UKLPG) of United Kingdom, NFPA 58 Liquefied Petroleum Gas Code issued by the National Fire Protection Association of USA, the safety requirements issued by the Gas Standards Office of Electrical and Mechanical Services Department and the Fire Services Department over the past years, and other relevant international standards related to LPG.

This module was first prepared jointly by the Gas Standards Office and the LPG Safety and Technical Committee (LPGSTC) represented by the Registered Gas Supply Companies of the LPG industry at that time, and was issued in 1996 after the enactment of the Gas Safety Ordinance in 1991. It was since then updated once in September 1999 (Issue 2). This Issue 3 is an update to capture the changes in technology and international standards since 1999 and to incorporate the experience of the stakeholders in the local LPG industry over the past years.

While this module tends to be specific in important aspects affecting safety and reliability, it shall be seen as offering guidance to engineers, operators and other users, who shall continue to exercise judgement and skill in the fulfilment of their obligations. It shall be borne in mind that practice may need changes with emerging technology and experience. The requirements listed in this document shall not be regarded as a set of rules that cannot be changed. It is expected that the document will be reviewed and updated as required.

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APPENDICES

SECTION 1 INTERPRETATION OF TERMS

Aboveground tank - A bulk tank which is located above ground level and not covered by sand or earth.

Bulk tank - A receptacle for storing LPG with a water capacity of more than 450 litres.

Competent Person - A person who is, by virtue of his/her qualifications, training and substantial practical experience, enlisted by the Gas Standards Office to perform / supervise / inspect / certify LPG installation, testing, and maintenance work as appropriate to the class to which he / she is enlisted.

> **Note**: *The applications for and lists of the various classes of Competent Persons and their responsibilities are obtainable from the Gas Standards Office or the EMSD website.*

Cylinder - A portable receptacle for storing LPG with a water capacity of not more than 150 litres.

Cylinder store

> **Piped-cylinder store -** A store containing cylinders connected together via a manifold piping system.
>
> **Standby cylinder store** - A store containing unconnected cylinders for standby purpose.

Emergency shut-off valve - A shut-off valve incorporating manual plus thermal means of shutting off gas supply in an emergency.

Excess-flow valve - A device designed to close when the liquid or vapour passing through it exceeds a prescribed flow rate.

Fill-connection – An assembly of pipework and valves on a rigid support frame for the purpose of off-loading LPG from road tanker to bulk tank, usually by means of flexible hose, but other means such as metallic unloading arms or LPG compressors may also be used.

Flameproof enclosure - Ex "d" as defined in EN 60079-1. A type of protection in which the parts, which can ignite an explosive atmosphere, are placed in an enclosure which can withstand the pressure developed during an internal explosion of an explosive mixture, and which prevents the transmission of the explosion to the explosive atmosphere surrounding the enclosure.

Gas Authority - The authority appointed under Section 5 of the Gas Safety Ordinance (Cap. 51).

Gas Standards Office (GasSO) - An office within government which is under the control of the Gas Authority to administer the Gas Safety Ordinance (Cap. 51).

Gas supply company – the Registered Gas Supply Company (RGSC) that is supplying LPG to the installation as defined in the Gas Safety Ordinance (Cap. 51).

Gas Systems Contractor – a Registered Gas Contractor who is authorized to carry out works for installation, commissioning and maintenance of LPG tanks, vaporisers, LPG pipework, pressure regulators and associated equipment in LPG compounds, cylinder stores as well as LPG mains, based on the class of Competent Person employed.

> **Note**: *The application for and list of Gas Systems Contractor is obtainable from the Gas Standards Office or the EMSD website.*

Hazardous area - An area in which an explosive gas atmosphere is, or may be expected to be, present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

Hot work - Welding or the use of any flame or electric arc or the use of any equipment likely to cause heat, flame or spark. It also includes caulking, chipping, drilling, riveting and any other heat producing operation, unless it is carried out in such a way as keep the temperature of the tools and work below 100^{o}C.

Installation boundary – Boundary of LPG compound or cylinder store.

Intrinsically safe - Ex "I" as defined in EN 60079-11. This is confining electrical energy to the installed system so that a hazardous environment cannot be ignited; and protecting the integrity of the circuit from intrusion of energy from other electrical sources so that the safe energy limitation in the circuit is not exceeded, even when breaking, shorting or earthing of the circuit occurs.

LPG - Liquefied petroleum gas as defined under the Gas Safety Ordinance (Cap. 51).

LPG compound - A bulk LPG storage installation with bulk tanks as receptacles, including vaporisers, pressure regulators, piping systems and tanker bay.

LPG pressure, high		- A pressure of more than 69 kPa
	medium	- A pressure of between 6.9 kPa and 69 kPa
	low	- A pressure of not more than 6.9 kPa

> **Note:** *These pressures are specific for LPG and not the same as those stipulated in the Gas Safety Ordinance.*

Manifold system - A system consisting mainly of steel pipework and flexible gas tubing with change-over devices for connecting cylinders in transferring LPG either in liquid phase through vaporisers or in vapour phase to end users.

Mounded tank - A bulk tank which is located above ground level and covered with sand or earth.

Notifiable gas installation (NGI) - An installation, as defined in the Gas Safety (Gas Supply) Regulations, including all LPG compounds, cylinder stores and vaporiser rooms.

NGI owner – A person or company that has been granted construction approval and approval of use of the NGI and is deemed to own the NGI for the purpose under the Gas Safety Ordinance (Cap. 51).

Off-loading - Transferring LPG from road tankers to bulk tanks.

Piping system - A system made up of pipes, tubings, valves and fittings, etc., for conveying LPG in either liquid or vapour state at various pressures from one point to another.

Pressure regulator - A device which automatically controls the pressure of gas in a gas pipe.

Primary pressure regulator - A pressure regulator for reducing LPG vapour at high pressure from tanks or cylinders to medium pressure.

Secondary pressure regulator - A pressure regulator installed to receive LPG vapour at medium pressure and supply LPG at low pressure to the downstream piping system.

Pressure relief valve - A valve designed for preventing a rise of internal pressure in excess of a specified value due to emergency or abnormal conditions.

Purging - Replacing the content in a system by inert gas before putting it into or out of service.

Road tanker - A motor vehicle designed and constructed for the conveyance of LPG in bulk on roads.

Safe area (non-hazardous area) - An area in which a flammable gas mixture is not expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

Source of ignition - Material, devices or equipment which, because of their modes of use or operation, are capable of providing sufficient thermal energy to ignite a flammable gas mixture when in contact with them.

Sterile area - A clear area that restricts planting, growth of vegetation, accumulation of combustible materials and blockage of access.

Tanker bay - An area of the LPG compound where a road tanker is parked during off-loading operations.

Underground tank - A bulk tank which is located below ground level and covered with sand or earth.

Vaporiser - An equipment used to provide heat for vaporisation of LPG.

Flameproof vaporiser - A vaporiser with all electrical parts contained in a flameproof enclosure.

Water capacity - The amount of water in volumetric units at 15.6^{o}C required to fill a container completely.

SECTION 2 OBJECTIVES AND SCOPE

2.1 Objectives

This Module has been prepared as a general outline of minimum safety standards to be followed for the design, construction, testing and commissioning, operation, inspection and maintenance of LPG compounds and cylinder stores in order to ensure the health and safety at work of the personnel involved and to ensure the LPG compounds and cylinder store being operated in a safe manner so that members of the public are not exposed to undue risks from gas.

2.2 Scope

2.2.1 This Module covers the statutory requirements, design, installation, operation, inspection, maintenance and decommissioning of LPG compounds and cylinder stores at consumer premises. It encompasses tanks, cylinders, fittings, vaporisers, pipework, primary regulators, secondary regulators installed within the compounds or stores, off-loading facilities, electrical equipment, fire protection, plant location and layout, etc. Maximum storage capacity per installation is limited to 40 tonnes, with a maximum individual bulk tank storage capacity of 20 tonnes, above which special considerations shall be required.

Note: *Installations described under this Module are notifiable gas installations as defined in the Gas Safety Ordinance and the construction and use of such installations shall require approval of the Gas Authority in accordance with Gas Safety (Gas Supply) Regulations 3 to 6.*

2.2.2 This Module does not cover:

a) storage of LPG at tank farms or storage terminals;

b) LPG-Air plants;

c) refrigerated or partially refrigerated storage; or

d) design and construction of cylinders.

2.2.3 The design and installation requirements in this Module shall, unless specified otherwise, apply to new installations and major alterations to NGIs, of which the applications for construction approval are made after the effective date of this Module. The operation and maintenance requirements in this Module shall apply to all new and existing installations. For cases of construction approval applications covering major alterations, the Gas Authority will review the situations case by case with NGI owners on mitigation measures for compliance.

Note: *SI units shall be used for new installations. Other units are also permitted with SI unit in brackets.*

2.2.4 LPG supplied to LPG compounds and cylinder stores shall meet the following specifications:

a) consisting predominantly of butane and propane, and containing no harmful quantities of toxic or nauseating substances;

b) containing no water, as ascertained by a visual examination of samples, at 15.6^{o}C, taken from the bottom of the containers;

c) containing not more than 0.02% (by mass) total sulphur content (see the Gas Safety (Gas Quality) Regulations), to be tested by the method described in ANSI/ASTM D2784 or similar, after a stenching agent has been added; and

d) having a distinctive, unpleasant and non-persistent smell (irrespective of suppliers) at a dilution of 1:250 with air (approximately 20% Lower Explosive Limit), to be tested by the method described in BS 4250, or similar.

2.3 Interpretation of Terms

In this document, the terms “shall” and “should” have the following interpretations:

2.3.1 “Shall” (required by this module) is used to indicate a requirement which, it is intended, shall be complied with in full and without deviation.

2.3.2 “Should" (recommended by this module) is used to indicate a requirement which, it is intended, should be complied with unless, after prior consideration, deviation is considered to be acceptable.

2.4 Regulations and References

2.4.1 All gas installation work shall comply with the local statutory safety requirements. Particular reference shall be made to:

Gas Safety Ordinance (Cap. 51)

Gas Safety (Gas Quality) Regulations (Cap. 51A)

Gas Safety (Gas Supply) Regulations (Cap. 51B)

Gas Safety (Registration of Gas Supply Companies) Regulations (Cap.51E)

Gas Safety (Miscellaneous) Regulations (Cap. 51F)

Buildings Ordinance (Cap. 123)

Dangerous Goods Ordinance (Cap. 295)

Fire Services Ordinance (Cap. 95)

2.4.2 This Module makes reference to the following publications (latest editions of these publications shall be used as far as possible):

ANSI/ASME - American National Standards Institute/American Society of Mechanical Engineers

ASME Boiler & Pressure Vessel Code Section VIII – Pressure Vessels

ASME B1.5, ACME Screw Threads

ANSI B16.5, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys

ANSI B16.9, Factory Made Wrought Steel Butt-welding Fittings

ANSI B16.11, Forged Steel Fittings, Socket-welding and Threaded

ANSI/ASTM - American National Standards Institute/American Society for Testing & Materials

ASTM A53, Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless

ASTM D2784 – Standard Test Method for Sulphur in Liquefied Petroleum Gases (oxy-hydrogen burner or lamp)

API - American Petroleum Institute

Std. 607, Fire Test for Soft-seated Quarter-turn Valves

API 510, Pressure Vessel Inspection Code

AS – Standards Australia

AS 1210, Pressure Vessels

AS 1596, The Storage and Handling of LP Gas

AS 3788, Pressure equipment : In-service inspection

BSI - British Standards Institutio*n*

BS EN 470, Specification for inspection, access and entry openings for pressure vessels

BS EN 1057, Copper and copper alloys

BS EN 1092, Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories

BS EN 1563, Founding – Spheroidal graphite cast irons

BS EN 1564, Founding – Austempered ductile cast irons

BS 1600, Specification for dimensions of steel pipe for the petroleum industry

BS 3799, Specification for steel pipe fittings, screwed and socket welding for the petroleum industry

BS 4250, Specification for commercial butane and commercial propane

BS 4882, Specification for bolting for flanges and pressure containing purposes

PD 5500, Specification for unfired fusion welded pressure vessels

BS EN ISO 10497, Testing of valves. Fire type-testing requirements

BS EN 10216-1, Seamless steel tubes for pressure purposes

BS EN 10216-5, Stainless steel tubes for pressure purposes

BS EN 10253-2, Butt-welding pipe fittings

BS EN 10255, Non-alloy steel tubes suitable for welding and threading

BS EN 12819, LPG equipment and accessories. Inspection and requalification of LPG pressure vessels greater than 13m^3

BS EN 13636, Cathodic protection of buried metallic tanks and related piping

BS EN 60079, Explosive atmospheres. Equipment

BS EN 60529, Specification for degrees of protection provided by enclosures

CGA – Canadian Gas Association

CGA OCC-1, Recommended Practice – Control of External Corrosion on Buried or Submerged Metallic Piping Systems

EI – Energy Institute

Model Code of Safe Practice Part 1, The selection, installation, inspection, and maintenance of electrical and non-electrical apparatus in hazardous areas

Model Code of Safe Practice Part 15, Area classification code for installations handling flammable fluids

“Design, construction, modification, maintenance and decommissioning of filling stations” (also known as “The Blue Book”) jointly with The Association for Petroleum and Explosive Administration (APEA)

GB – China National Standard

GB 51142, Code for design of liquefied petroleum gas (LPG) supply engineering 液化石油氣供應工程設計規範

SY 5985, Liquefied petroleum gas safety stipulation 液化石油氣安全規程

TSG R7001, Pressure vessel periodical inspection regulation 壓力容器定期檢驗規則

Liquid Gas UK (Formerly UKLPG)

Code of Practice 1, Bulk LPG Storage at Fixed Installations
- Part 1, Design, Installation and Operation of Vessels Located Above Ground
- Part 3, Examination and Inspection
- Part 4, Buried/Mounded LPG Storage Vessels

Code of Practice 7, Storage of Full and Empty LPG Cylinders and Cartridges

Code of Practice 17, Purging LPG Vessels and Systems

Code of Practice 22, Design, Installation and Testing of LPG Piping Systems

NACE – National Association of Corrosion Engineers

SP-0169, Control of External Corrosion on Underground or Submerged Metallic Piping Systems

SP-0285, Corrosion Control of Underground Storage Tank Systems by Cathodic Protection

NFPA – National Fire Protection Association

NFPA 58, Liquefied Petroleum Gas Code

Publications of The Government of the HKSAR

Code of Practice for Hong Kong LPG Industry, Module 2 – Underground LPG Pipework, HKSAR

Code of Practice for Hong Kong LPG Industry, Module 3 – Handling and Transport of LPG in Bulk by Road, HKSAR

Code of Practice for Hong Kong LPG Industry, Module 7 – Operating Procedures for Emergencies for LPG Compounds & Cylinder Stores, HKSAR

Code of Practice for Hong Kong LPG Industry, Module 9 – LPG Cylinders, HKSAR

Code of Practice for LPG Filling Stations in Hong Kong, HKSAR

Code of Practice for the Electricity (Wiring) Regulations, HKSAR

Code of Practice for Fire Safety in Buildings, Buildings Department, HKSAR

Code of Practice for Minimum Fire Service Installations and Equipment, HKSAR

Code of Practice for Inspection, Testing and Maintenance of Installations and Equipment, HKSAR

Code of Practice for Avoiding Danger from Gas Pipes, HKSAR

Guidance Note on Liquefied Petroleum Gas Installations – Gas Safety (Gas Supply) Regulations Cap. 51 Sub Legislation B *(Regulations 1 to 14)* – Dec 2016

Guidance Note on Gas Supply Installations (Sept 2020), HKSAR

SECTION 3 STATUTORY REQUIREMENTS

3.1 Construction Approval and Approval of Use

3.1.1 Any LPG compound or cylinder store with storage capacity exceeding 130 litres aggregate nominal water capacity is classified as a Notifiable Gas Installation as defined under the Gas Safety Ordinance (Cap. 51). According to Regulations 3 to 6 of the Gas Safety (Gas Supply) Regulations, construction approval and approval of use shall be obtained from the Gas Authority (i.e., the Director of Electrical and Mechanical Services). The Gas Authority shall examine in details the design, installation, operation and maintenance of the LPG installation to ensure that it is in compliance with all safety regulations, standards and codes of practice as stipulated by the Gas Authority.

3.1.2 The construction approval and approval of use would not deem to confer any title to land or to act as a waiver of any term in any lease or licence or any approval from other authorities or government departments. In particular, any person who intends to carry out building works shall appoint an Authorized Person, and where necessary Registered Structural Engineer and Registered Geotechnical Engineer, to prepare and submit plans for the approval of the Building Authority under the Buildings Ordinance (Cap. 123).

3.1.3 Application for construction approval of an LPG installation shall be submitted in writing to the Gas Authority for consideration by using Form EMSD/GSO/104 with the following documentation (as applicable) and a prescribed fee (Refer to Schedule 1 of the Gas Safety (Gas Supply) Regulations): -

a) Copy of the applicant's business registration certificate

b) A written statement on the purpose of the installation and describing the buildings, containers and major elements

c) Two sets of plans showing the location including the surroundings, layout, major equipment, elevations and sectional views, schematic diagrams, pipe routing, details of underground piping and protection methods, fire services installation and equipment, emergency shutdown systems, LPG-related drainage, delivery route of road tanker/cylinder wagon, etc.

d) Supporting calculations for the estimated consumption amount and rates

e) Pipe flow calculations to substantiate the sizing of the distribution pipes, if appropriate

f) Supporting calculations for the vaporising capacity and the vaporiser PRV relief capacities

g) Calculations of the ventilation and explosion relief requirements

h) Cathodic protection system design

i) A list of all gas fittings, equipment and machinery to form part of, or to be used in connection with the installation

j) Construction programme (tentative, with key milestones)

k) Quantitative Risk Assessment report, if required (Refer to Section 3.3).

Drawings shall be of a suitable scale so as to be legible. The Gas Authority may request for more other relevant information if deemed necessary.

It is encouraged that, as an alternative, the application is to be submitted via the "e-Forms" through EMSD's on-line system, for saving processing time and enhancing operational efficiency.

3.1.4 Under Gas Safety (Gas Supply) Regulation 5, the Gas Authority is committed to process the construction approval within 60 days. However, if within the 60-day period, the Gas Authority requests the applicant to submit further details, documents or plans, the 60 days will be extended for another 30 days counted from the receipt of the supplementary documents. It is an offence to commence construction work for an NGI before construction approval is given.

3.1.5 Application for approval of use of an LPG installation shall be submitted in writing to the Gas Authority for consideration by using Form EMSD/GSO/105 with the following documentation and a prescribed fee (Refer to Schedule 1 of Gas Safety (Gas Supply) Regulations). Before applying for approval of use, the applicant shall have obtained the construction approval from the Gas Authority and completed all the construction work.

I) <u>For vapour withdrawal piped cylinder store</u>: Pipework pressure test certificate

II) <u>For liquid withdrawal piped cylinder store</u>: Pipework pressure test certificate and vaporiser test certificate

III) <u>For LPG compound</u>:

a) Approval of the LPG tank from the Gas Authority

b) Pipework pressure test certificate

c) Vaporiser test certificate

d) Cathodic protection system test report

e) Earthing impedence report

f) Electrical continuity test certificate for LPG pipework

g) Test report for electrical isolation of insulation flanges

IV) <u>For all types of installations as applicable</u>:

a) Work completion certificate for fixed electrical installations (WR1)

b) Calibration certificates for pressure gauges (only if not new) and thermometers (if fitted)

c) Certificate of flameproof type for electrical installations and equipment used in hazardous areas

d) Calibration, inspection and test certificate for gas detection system (if installed)

e) Certificate of Fire Service Installations and Equipment (F.S. 251) of fire service installations and, when applicable, a Fire Services Certificate (F.S. 172) or an acceptance letter/memo issued by the Director of Fire Services

f) Testing and commissioning programme of the LPG installation

g) Other relevant information if requested

3.1.6 The NGI owner shall not put the installation into use unless approval of use in writing has been obtained from the Gas Authority and the construction work has been completed. The testing and commissioning shall be completed satisfactorily in accordance with the requirements of Section 9, and the relevant reports shall be submitted to the Gas Authority as required before the commencement of operation of the installation is allowed.

3.1.7 According to Regulation 11 of the Gas Safety (Registration of Gas Supply Companies) Regulations, the NGI shall not be used to store LPG, unless:

a) the NGI owner is a RGSC;

b) the NGI owner is an employee of the RGSC storing such LPG in the course of his work as such an employee; or

c) the NGI owner has obtained approval in writing from the RGSC for storing such LPG.

In case of (c), a copy of the RGSC's approval letter shall be forwarded to the Gas Authority for retention at least 5 working days prior to the commencement of the gas storage. In the event of change of RGSC, the NGI owner shall obtain the approval in writing from the new RGSC for storing such LPG, and a copy of the new approval letter shall be forwarded to the Gas Authority at least one month prior to the effective date.

3.1.8 The approval of use shall be issued only to the same person or company that has obtained construction approval for the same NGI.

3.2 Approval of LPG Storage Tank

Under Regulation 7 of the Gas Safety (Gas Supply) Regulations, the approval of the LPG storage tank shall be separately obtained from the Gas Authority before the tank can be put into use. Form EMSD/GSO/110 with the following documentations shall be submitted:

a) Copy of the applicant's business registration certificate

b) Statement on the design standard / specification adopted

c) Details of the tank manufacturer

d) Design calculations based on the design standard used

e) Two sets of design drawings including details of the nozzle arrangements, details shown on the nameplate, etc.

f) Manufacturer's certificate of compliance, such as Certificate of Design Appraisal and Certificate of Inspection, issued by an independent party

g) Mill certificates and material traceability records

h) Reports / records of hydrostatic test, 100% radiography, magnetic particle / ultrasonic weld tests, Charpy impact tests, stress relief / post-weld heat treatment, dimensional and tolerance measurements, coating thickness measurements, holiday test, on-site testing & commissioning, etc.

i) Certificate of compatibility of the coating with the cathodic protection system

j) Welding specifications and welders' certificates

k) Details of fixing of the tank to the chamber (with calculations), and a statement from the manufacturer assuring that the fixing method is compatible with the tank

l) Two sets of as-built drawings including details of the nozzle arrangements, details shown on the nameplate, etc., certified by an independent party

m) Details of fittings connected directly to the tank

For all new LPG compounds in Hong Kong, only bulk tanks designed for underground or mounded installation shall be allowed.

Under Gas Safety (Gas Supply) Regulation 7, it is an offence to introduce LPG in any form (vapour or liquid) or quantity into a tank prior to obtaining tank approval as applied for with Form 110.

3.3 Quantitative Risk Assessment

3.3.1 A Quantitative Risk Assessment (QRA) shall be required for an installation as a part of the construction approval process when the installation involves LPG storage in bulk and replenishment of LPG on-site by means of LPG road tankers. The NGI owner shall employ an independent risk assessment consultant to prepare a QRA report to demonstrate that the risk levels associated with the proposed installation, taking into consideration the estimated population in the future, are in compliance with the Risk Guidelines as stipulated in the Hong Kong Planning Standards and Guidelines (HKPSG).

3.3.2 The criterion for individual risk is that no person off-site shall be subject to an additional risk of 1×10^{-5} / year due to the operation of the LPG installation. For societal risk, the risk curve should fall within the "Acceptable" region in the "Societal Risk Guidelines for Acceptable Risk Levels" stated in the HKPSG. If it falls within the As Low as Reasonably Practicable (ALARP) region, cost-effective mitigation measures shall be taken to further reduce the risk.

3.3.3 The QRA report shall take into account the bulk LPG storage, interaction of LPG and other flammable fuels (if applicable), site topography, meteorological conditions,

ignition sources, and existing as well as planned populations in the vicinity of the installation.

3.3.4 Construction approval will not be granted until the Gas Authority has accepted the QRA report. For construction approval applications involving major alterations, a fresh QRA may be required if the proposed alterations change the basis of the original QRA.

3.4 Duties of NGI Owner

3.4.1 According to Regulation 6B of the Gas Safety (Gas Supply) Regulations, the NGI owner has the responsibility to ensure that the installation and the equipment therein are operated and maintained in a safe manner. The NGI owner therefore needs to have the proper competence to be able to discharge this responsibility.

3.4.2 The NGI owner should make arrangements with the RGSC, Competent Persons and/or Gas Systems Contractors for complying with the requirements of the Regulations.

3.4.3 The NGI owner should provide proper training to his staff on operation, maintenance instructions and emergency response procedures, so as to ensure that the NGI is operated and maintained in a safe condition.

3.4.4 According to Regulation 6C of the Gas Safety (Gas Supply) Regulations, the NGI owner shall employ a Class 2 Competent Person to carry out inspections on the installation to ascertain whether the installation is operated and maintained in accordance with Regulation 6B of the Gas Safety (Gas Supply) Regulations. The inspections shall be carried out at intervals of not less than once every year. The NGI owner shall rectify any outstanding irregularities identified and listed in the inspection report (Form 109) as soon as practicable or within a period to be agreed with the Competent Person as part of the inspection. The NGI owner shall submit a copy of the inspection report (Form 109) to the Gas Authority within four weeks after the inspection. Inspection reports of the installation shall be kept by the NGI owner for the service life of the installation.

SECTION 4 PLANT LOCATION AND SAFETY REQUIREMENTS

4.1 LPG Compounds

4.1.1 General Requirements

4.1.1.1 Sites for LPG compounds shall be so located as to provide suitable distances away from habitable areas. In addition, they shall be situated in locations which are well ventilated and which, so far as can be reasonably foreseen, will remain so, even upon subsequent development of adjacent sites.

4.1.1.2 LPG compounds shall be easily accessible for operation, maintenance, fire-fighting purposes and replenishment of LPG (see Gas Safety (Gas Supply) Regulation 11(b)) but inaccessible to the public or other unauthorised persons.

4.1.1.3 LPG compounds shall be designed to facilitate gas dispersion in the event of LPG releases and to minimise, so far as is practicable, the risk of escaped LPG from being ignited before being dispersed or diluted (see Gas Safety (Gas Supply) Regulation 11(c)).

4.1.1.4 The grading of an LPG compound shall be such that LPG spillage will not collect beneath a parked road tanker.

4.1.1.5 The storage capacity of the compound shall have sufficient reserve so that in the event of a disruption to the normal replenishment schedule, the storage is capable of providing continuity of gas supply.

Note: *The storage of LPG should normally have an aggregate capacity of four times the average foreseeable daily demand. Higher stock may be considered especially at remote sites where replenishment is a problem.*

4.1.1.6 Consideration should be given to install more than one bulk tank, where appropriate, to facilitate future tank maintenance/revalidation.

4.1.1.7 The site selection for an LPG compound shall be subject to the results of the QRA being acceptable to the Gas Authority. (Section 3.3 refers).

4.1.1.8 When there is adequate space available, it should be preferable to avoid vehicular loading above underground bulk tanks.

4.1.1.9 Guidance Note on Gas Supply Installations (Applicable to Conventional Projects and Projects with Modular Integrated Construction) which can be downloaded at the EMSD website should be read in conjunction with this section.

4.1.2 Perimeter Fence

4.1.2.1 An LPG compound shall be enclosed on the installation boundary by a perimeter fence which shall be at least 1.8 m high and be as open as possible to allow for cross-ventilation of the site, without negating the security purpose.

4.1.2.2 The major components (bulk tanks, tanker bay, piping, vaporisers) shall be enclosed within the LPG compound. Where this is not possible in case of industrial premises, these shall be within the lot boundary.

4.1.2.3 The perimeter fence around the LPG compound shall have a minimum of two exits located as far apart as possible from each other. One exit may be the main gate while the second exit needs only be large enough for a person to exit. The gates at the exits shall not be self-locking and shall open outwards to provide for easy exit from the compound. The second exit shall be lockable only from the inside.

4.1.2.4 Components in locations that can be damaged by vehicular movements including those inside the compound shall be suitably protected by devices such as crash barriers, bumper posts and/or concrete curbs. These protection devices shall not be installed in such a way as to impair the ventilation of the compound.

4.1.2.5 The perimeter fence shall be bunded to a height of 150 mm to contain small spillage. At the road tanker entrance, a "speed bump" shall be installed to maintain the above bunding and to ensure that the road tanker will be moving at safe speeds when inside or near to the compound.

4.1.2.6 Warning signs and emergency instructions in both English and Chinese shall be posted near each entrance on the outside wall/fence of the installation. The size of letters/characters of the warning signs, e.g., "NO SMOKING", "LPG HIGHLY FLAMMABLE" and "LPG STORE", shall be of 120 mm minimum in height.

4.1.2.7 The main control valve shall be suitably identified with label and so positioned as to be easily accessible in the event of an emergency. The valve shall be accessible from outside the perimeter fence and shall have means of preventing unauthorised operation.

4.1.2.8 Where the LPG compound is within a larger lot and the NGI owner has reasonable control on the area immediately outside the LPG compound, a sterile area of at least 1 m shall be provided around the LPG compound, paved with concrete and conspicuously marked with yellow lines. Where it is not possible for the NGI owner to maintain control on such an external sterile area, and where the safety distance requirements have been met wholly within the LPG compound, the sterile area may be provided immediately within the perimeter fence of the LPG compound.

4.1.3 Bulk Tank Location

4.1.3.1 Bulk tanks shall be either underground or mounded and set inside individual vessel chambers sealed against the ingress of water, with separation distances in accordance with the table and diagram in Appendix B.

4.1.3.2 Bulk tanks shall not be installed closer than 6 m to any aboveground vessel or bund wall of vessels containing other flammable liquids with a flash point below 60^{o}C.

4.1.3.3 Bulk tanks shall not be installed in basements.

4.1.3.4 The distance from the valve assembly on the manhole cover and the fill-connection of the LPG compound to the installation boundary where the general public have legitimate access shall be at least 3 m.

4.1.3.5 The distance between the bulk tank and the installation boundary shall be at least 1.5 m and the vessel chamber around the bulk tank shall be wholly within the installation boundary.

4.1.3.6 The distance from the valve assembly on the manhole cover~~,~~ and fill-connection of the LPG compound to the lot boundary or fixed point of ignition shall be at least 7.6 m.

4.1.3.7 The discharge of PRV vent shall be:

- at least 1.5 m away from any building openings that are below the level of discharge, and
- at least 3 m away from fixed sources of ignition, openings to direct vent appliances and mechanical ventilation intakes.

4.1.4 Tanker Bay

4.1.4.1 Tanker bay shall be in a designated area not accessible by the public.

4.1.4.2 The surface of tanker bay shall be graded as such to prevent collection of LPG spillage underneath the parked road tanker.

4.1.4.3 If the drainage system connects to a public drain, there shall be an LPG trap incorporated into the design to prevent any LPG releases from entering the public drains. See Appendix C for typical design for an LPG trap.

4.1.4.4 Any open block and/or chain link fence enclosing the entire compound should be sufficiently open to allow for dispersion of any small LPG releases.

4.1.4.5 Crash barriers should normally not affect dispersion of LPG vapour in the event of a release unless they are specially designed as an integral structure for containment.

4.1.5 Fill-connection

4.1.5.1 Fill-connection should be as close to the bulk tank as practicable but not be located inside the valve chamber. It shall be extended to be outside the tank valve chamber and positioned in such a way as to prevent unnecessary bending of the delivery hose.

4.1.5.2 Where more than one bulk tank is installed, the liquid filling lines of the bulk tanks shall be separated by valves in the piping system to enable isolation of each bulk tank during operations.

4.1.5.3 Vapour equalizing line shall not be used during normal off-loading of road tanker.

4.1.5.4 The fill-connection shall be within the LPG compound or within the lot boundary in case of the industrial premises.

4.1.5.5 The fill-connection shall be protected against the possibility of mechanical damage by road tankers. Concrete posts, precast concrete curbs or similar barriers shall be used wherever exposure to damage is possible. Fill-connections should be positioned away from the backing direction of road tanker if practicable.

4.1.5.6 A double check valve shall be installed at the fill-connection to prevent the outflow of LPG liquid under abnormal conditions, e.g., fill pipe rupture.

4.1.5.7 Drive-away protection shall be provided in accordance with Gas Safety (Gas Supply) Regulation 40. This can be a suitable drive-away protection installed on the tank truck unloading hose.

4.1.5.8 Fill-connection point shall be structurally supported adequately with sufficient strength and protected to prevent failure due to the use of drive-away protection device.

4.2 Cylinder Stores

4.2.1 General Requirements

4.2.1.1 Cylinder stores shall be located in a well-ventilated area and shall be easily accessible for replacement of cylinders and emergency services (see Gas Safety (Gas Supply) Regulations 11(a) and (b)).

4.2.1.2 Requirements of Sections 4.1.1.3 and 4.1.1.5 shall also be complied with.

4.2.1.3 The maximum capacity of a piped-cylinder store shall be 1 000 kg. LPG cylinders are considered to be full irrespective of the state of their contents.

Note: *Standby cylinder stores could be considered, especially at remote sites where replenishment may encounter problems.*

4.2.1.4 Warning signs and emergency instructions shall be referred to Section 4.1.2.6.

4.2.1.5 A sterile area of at least 1 m shall be provided around the cylinder store and should have yellow lines conspicuously marked on the floor.

4.2.1.6 Only one LPG store shall be constructed within a lot boundary except for remote sites or sites of a large lot where one store serving the same site is not practicable.

4.2.1.7 Drains shall be avoided in the floor area or in the immediate vicinity of the cylinder store, i.e., within 3 m of the cylinder store (or 2 m in the case of storage below 400 kg). Where a gully or drain is unavoidable within this distance, the openings shall either be securely covered or the drain suitably sealed.

4.2.1.8 Cylinder stores shall be readily accessible at ground level and never below it in cellars or in basements. The floor of the stores shall be level, free from depressions and paved with concrete.

4.2.1.9 The storage arrangement of cylinders in standby cylinder stores shall conform to the following:

a) The gangway between palletised stacks shall be not less than 2.5 m.
b) The gangway between unpalletised stacks shall be not less than 1.5 m.
c) The maximum height of a stack shall not exceed 1.6 m.

4.2.1.10 Normally, no electrical apparatus shall be installed within the cylinder store or outside within the classified area as defined in Appendix F; however, if electrical apparatus is required within this area, the requirements of Section 7 shall be adhered to.

4.2.1.11 Cylinder stores shall be separated from other buildings or boundary by separation distances in Table 4-1, or from other parts of the building by an imperforated wall of not less than 2 hours fire resistance rating for storage inside building.

4.2.1.12 Access to storage area shall be properly controlled. Cylinder stores shall be enclosed by walls or an industrial type fence not less than 1.8 m high unless it is otherwise adequately protected (e.g., within a greater fenced area). The fence shall have at least two exits not adjacent to one another if the escape travel distance from any part of the cylinder store to the exit is more than 12 m around the cylinder store. Gates/doors shall open outwards so as not to impede the escape route; they shall not be self-locking and they shall provide easy means of escape from within at all times.

4.2.1.13 Piped-cylinder stores shall be provided with a roof constructed from non-combustible materials.

4.2.1.14 Cylinder stores shall be used to store LPG cylinders only, and shall be segregated by suitable separation distances away from other hazardous stores, e.g., as follows:

a)	Compressed gas cylinders (except fire extinguishers)	3 m
b)	Acetylene cylinders	3 m
c)	Tanks containing flammable liquids	3 m
d)	Toxic, corrosive, or flammable substances	3 m
e)	Liquid oxygen	7.5 m

4.2.1.15 The floor of a cylinder store shall be level or shall slope towards the ventilated external wall. Store entrance shall be provided with a ramp if necessary.

4.2.1.16 Cylinder store inside building shall be of robust construction and separated from the rest of the building (except vaporiser room) by imperforated walls, ceilings, floors, etc., of not less than 2 hours fire resistance rating.

4.2.1.17 Cylinder store in a building which includes residential accommodation is not recommended.

4.2.1.18 The minimum separation distance from any aperture of cylinder stores to any nearest aperture of buildings (except LPG store itself and vaporiser room), or to the boundary (except where this is an imperforated wall of at least as high as the aperture and having at least 2 hours fire resistance rating), or to any fixed source of ignition, or to smoking area or vehicle parking areas (except LPG cylinder wagon), shall be 1 m for storage quantity up to 400 kg or 3 m for storage quantity of 400-1000 kg. In case a wall full of openings (i.e., a wall having at least 80 % of its area opened for effective ventilation at all levels) is used as physical separation between the cylinders and the public, the distance could be measured from the cylinder.

4.2.1.19 Cylinder stores shall be constructed with ventilation and explosion relief in accordance with the requirements in Section 5.8.

4.2.1.20 Building walls of a cylinder store may be built on the boundary provided that they are imperforated and have a fire resistance rating of not less than 2 hours.

4.2.1.21 The ventilated exterior wall of a piped-cylinder store shall not be situated at the lot boundary facing directly to a public pavement. Ventilated apertures shall be located in accordance with the separation requirements of Section 4.2.1.18.

4.2.2 Radiation Walls

4.2.2.1 Radiation walls may permit separation distances to be reduced.

4.2.2.2 Radiation walls shall be imperforated, and substantially constructed of brick, concrete, or other inert materials, and have a fire resistance rating of not less than 2 hours in accordance with the Code of Practice for Fire Safety in Buildings.

4.2.2.3 The height of radiation walls shall be at least as high as the highest stack of LPG cylinders and shall be of such a width that the distance from the cylinder store to the boundary, building or fixed ignition source measured around the end of the wall is not less than the separation distance specified in Table 4-1.

4.2.2.4 For a cylinder store without a roof and in which the radiation wall is a building wall, the following additional requirements shall be met:

a) There shall be no openings in the wall above the LPG cylinders up to a height of 9 m or within 2 m horizontally.
b) There shall be no overhanging eaves or similar projections constructed from combustible materials above any stored cylinders. No external stairway or fire escape shall be positioned above and around the LPG cylinders.

4.2.2.5 A radiation wall may be built on a boundary, but in such a case, it shall be wholly under the control of the owner of the cylinder store.

4.3 Vaporiser Location

4.3.1 No direct-fired or non-flameproof vaporisers shall be used for new installations and shall not be installed closer than 1.5 m from any LPG bulk tank or cylinder.

4.3.2 The distance between vaporisers and the nearest building or boundary line of adjoining property shall be 3 m minimum.

4.3.3 For remote fired boiler type vaporisers, the boiler shall be located more than 4.6 m from the vaporiser.

4.3.4 Vaporisers shall be installed in dedicated buildings constructed as per LPG cylinder stores. Relevant location requirements shall be in accordance with Section 4.2.1. Installation of vaporisers outdoors is not recommended.

4.3.5 For remote fired boiler type vaporisers, if the hot water is recirculated, the boiler shall be installed in a dedicated building constructed as per LPG cylinder store. Relevant location requirements shall be in accordance with Section 4.2.1.

4.3.6 Warning signs such as “LPG VAPORISER ROOM” in both English and Chinese shall be posted at the outside wall of the vaporiser room, and the size of the letters/characters shall be of 120 mm minimum in height.

4.3.7 Where a vaporiser room is a standalone structure or attached to other buildings, the following requirements shall be complied with:

a) The vaporiser room is located at ground level.
b) The vaporiser room is of single storey construction.

4.3.8 Where a vaporiser room is within a building, the following requirements shall be complied with:

a) The building is used exclusively for industrial and/or commercial use.
b) The vaporiser room is located on the ground floor, the floor is not located below the surrounding level, and the building in which the room is located does not have a basement or unventilated crawl space.

Table 4-1
Minimum Separation Distances for Cylinder Stores

Installation capacity	(1)	(2)
Below 400 kg	1 m	Nil
400 – 1000 kg	3 m	1 m

(1) Minimum separation distance from lot boundary/building or fixed ignition source to the nearest cylinder (where no radiation wall is provided)

(2) Minimum separation distance from lot boundary/building or fixed ignition source to the radiation wall (where provided, details as per Section 4.2.2)

Note: *Larger standby cylinder storage quantities with greater separation distances may be considered especially at remote sites where delivery is a problem.*

4.4 Other Safety Considerations

4.4.1 Separation from Power Cables

4.4.1.1 Aboveground LPG tank and LPG cylinders shall not be installed below overhead cables unless protected by a suitable screen bonded to earth:

a) Within 1.5 m from a line drawn vertically downwards from a power cable operating at voltages below 1.0 kV.

b) Within 10 m from a line drawn vertically downwards from a power cable operating at voltages of 1.0 kV or above.

4.4.1.2 For the purposes of this code of practice, telephone and data cables are not classified as power cables.

4.4.2 Protection against External Hazards

4.4.2.1 In layout and design of LPG compound or cylinder store, the risks of external hazards should be taken into consideration. Examples are:

a) Vehicular impact due to proximity to roadways.

b) Falling trees or broken branches impacting onto LPG facilities.

c) Stability of nearby slopes.

d) Proximity of LPG facilities to the waterfront, with the risk of unusually high tide during typhoon strikes.

4.4.2.2 The NGI owner needs to identify such risks at the design stage, and should constantly review the situations as circumstances may change over time. If any such risks are identified, he should either take proper preventative measures (e.g., bollards to guard against vehicular impact), have contingency measures available (e.g., temporary dike facilities to guard against high tides) or have monitoring programmes in place (e.g., slope stability monitoring).

SECTION 5 DESIGN

5.1 General

5.1.1 All equipment used on LPG installations shall be suitable for the conditions of use, e.g., temperature, pressure, compatibility, area classification, etc., and should be easily accessible for operation, maintenance and fire-fighting purposes.

5.1.2 All electrical equipment used in hazardous areas shall have the appropriate IEC labelling indicating the protection type, gas group and temperature class, or EPL (equipment protection level) labelling, or ATEX (Atmospheres Explosible directives from the EU) labelling, indicating that they are appropriate for use in the particular hazardous zone.

5.1.3 All safety equipment (e.g., remote-control emergency shut-off valves, pressure and temperature sensing devices, fusible links, etc.) shall be appropriate for their intended use.

5.1.4 Cast-iron equipment and components shall not be used for LPG installations. Other materials such as bronze, brass, copper, etc., that are confirmed as suitable for LPG service may be used.

5.1.5 All rubber components shall be of grade and quality suitable for LPG service.

5.1.6 Pressure-containing parts shall be made of steel, nodular iron, malleable iron, bronze or brass. Where nodular iron is used, it shall be in accordance with BS EN 1563 or BS EN 1564 or equivalent. Internal parts and components shall be corrosion resistant.

5.1.7 Records of an LPG installation detailing equipment inventory shall be kept and updated for the service life of the installation.

5.1.8 A copy of updated site layout plan and schematic diagram of LPG compounds or piped-cylinder stores shall be kept on site for operation and emergency uses. For typical schematic diagrams, see Appendices D and E.

5.2 Bulk Tanks

5.2.1 General Requirements

5.2.1.1 Bulk tanks shall be designed and constructed in accordance with PD 5500 or equivalent, such as AS 1210 or ANSI/ASME Boiler & Pressure Vessel Code Section VIII. Use of partial standards shall not be allowed.

5.2.1.2 Bulk tanks shall be post-weld heat treated in accordance with the respective codes for the bulk tanks and shall be subject to 100% radiography examination and a satisfactory `Charpy' test at the minimum design temperature.

5.2.1.3 The steel used in bulk tanks shall be certified by the manufacturer as satisfying the design code for LPG service.

5.2.1.4 Bulk tanks shall be designed to a minimum pressure of 1.725 MPa and a minimum design temperature of -10^{o}C or lower.

5.2.1.5 Bulk tanks shall be provided with a minimum of 1 mm additional wall thickness for corrosion allowance.

5.2.1.6 Bulk tanks shall be provided with steel saddles for mounting and with lugs for lifting in compliance with the design code.

5.2.1.7 An information plate shall be securely fixed to the bulk tank at a clearly visible location which shall contain the following information:

a) manufacturer and serial number;
b) date of manufacture;
c) design code;
d) water capacity in kilolitres;
e) maximum working pressure in kPa;
f) design temperature range in degree centigrade - minimum and maximum;
g) the test pressure and date of test; and
h) marking of inspecting authority.
i) sufficient space shall be provided to mark subsequent retest dates.

This information plate shall be affixed to an integral part of the tank (e.g., tank shell or manhole) at the time of manufacture so that it is not to be detachable.

Note*: In addition to the above information plate that is supplied integral with the tank at the time of manufacture, there shall be affixed on the tank, inside the tank turret or at an alternative convenient location visible after the burial of the tank, a second plate duplicating the above information. This plate should have sufficient space to mark subsequent retest dates.*

5.2.1.8 Records of bulk tanks shall be kept and updated for the service life of the bulk tanks and shall include the following:

a) detailed design drawings including nozzle arrangements and fittings;
b) steel plate mill certificates;
c) weld test reports;
d) welder's certificates;
e) manufacturer's certificate of compliance; and
f) all test and inspection certificates.

5.2.1.9 Each bulk tank shall be provided with the following valves and fittings which shall be identified with suitable labels:

a) duo-port pressure relief valves;
b) shut-off valve and excess flow valve for liquid withdrawal;
c) shut-off valve and excess flow valve for vapour withdrawal;

d) shut-off valve and double check valve for fill-connection;
e) fixed level device connected with pressure gauge;
f) content gauge; and
g) plugged shut-off valve for drain connection.

5.2.2 Vessel Chamber

5.2.2.1 Each bulk tank installed in HKSAR, either underground or mounded, shall be installed in an individual vessel chamber filled with washed sand, earth or other approved inert materials and provided with cathodic protection. The vessel chamber shall be wholly within the installation boundary of the LPG compound.

5.2.2.2 The vessel chamber is commonly of reinforced concrete (RC) construction with base, walls and top slab designed and constructed in accordance with the provisions of the Buildings Ordinance (Cap. 123). The main functions of the chamber are to maintain the minimum required thickness of sand, earth or other approved inert materials around the bulk tank at all times, prone against radiation from fire, erosion, weathering, washing out, seepage or any other form of disturbance.

5.2.2.3 When located under driveway the vessel chamber shall be designed to withstand the loads from vehicular traffic.

5.2.2.4 The vessel chamber shall be designed to support the total load of the bulk tank fully filled with water and filled material.

5.2.2.5 The anchorage system for the bulk tank shall be capable of withstanding the maximum residual floating force of the empty tank assuming the vessel chamber is totally flooded.

5.2.2.6 The vessel chamber shall be properly sealed to prevent ingress of water.

5.2.2.7 For a RC chamber:

(a) The walls shall be imperforated and have a thickness of 200 mm minimum
(b) The clearance between the bulk tank and the walls shall be of 150 mm minimum for achieving the required fire protection but preferably 300 mm to 450 mm if space is available so as to provide more physical clearance during the lifting of the tank in and out of the chamber.
(c) Bottom clearance shall not be less than 200 mm.
(d) The whole RC chamber shall have the wall and slab thicknesses, steel bar sizing and all other RC details determined by the structural design, except that a minimum wall thickness of 200 mm and a minimum top slab thickness of 100 mm shall be provided.
(e) The minimum thickness of sand or other forms of backfill around the tank shall be 150 mm on the sides and at the top and 200 mm at the bottom.

5.2.2.8 If located outside the driveway, the underground concrete chamber may be designed to have the top protruding above the surrounding ground level (but not yet as mounded). This type of underground chamber as well as the chamber used

for mounded tanks, together with the pipework that may be exposed, shall have adequate means of protection against any possible vehicular impact, e.g., with the use of crash barriers, bollards, etc. The use of precast concrete beams / slabs as the top of the chamber may be allowed, subject to design by a professional structural engineer, and shall be of a minimum thickness of 100 mm and with adequate sealing of the joints to prevent the ingress of water from the top.

5.2.2.9 Chamber vent pipes shall be provided diagonally in each vessel chamber to allow for periodic checks on LPG leakage and ingress of water. The vent pipe shall be extended to a point below the bottom level of the bulk tank.

5.2.2.10 Chamber vent pipes shall be straight and shall have a nominal bore of 20 mm minimum. Each vent pipe shall be protruded from the ground and provided with a rain cap to prevent ingress of water.

5.2.3 Corrosion Protection

5.2.3.1 Exterior surface of a bulk tank shall be suitably treated by shot-blasting and be cleaned to exclude all rust, grease and dusts prior to applying surface coating.

5.2.3.2 Exterior surface of a bulk tank shall be covered and bonded with a corrosion resistant coating (see Gas Safety (Gas Supply) Regulation 12(1)) which shall:

a) provide electrical insulation between the bulk tank and earth;
b) be inert, non-absorbent to moisture, of high dielectric strength and of sufficient mechanical strength to resist damage during installation; and
c) have sufficient flexibility to allow for any damage due to expansion or contraction of the bulk tank.

5.2.3.3 Each bulk tank shall be protected with a cathodic protection system with a test point for such system (see Gas Safety (Gas Supply) Regulation 12 (1)). The design and construction of the cathodic protection system shall be carried out by cathodic protection specialists in accordance with recognized standards such as NACE SP-0285 or BS EN 13636.

5.2.3.4 Where sacrificial anodes are employed for the cathodic protection system, they shall be provided in accordance with Sections 5.2.3.5 - 5.2.3.6.

Note: *For further details, refer to latest versions of NACE SP-0169, SP-0285 and CGA OCC-1*.

5.2.3.5 The size and number of anodes shall be designed by cathodic protection specialists such that the anodes are capable for corrosion protection of the bulk tank before its next revalidation date.

5.2.3.6 The choice of anodes shall be based on the surface area of the bulk tank and the test results on the conditions (PH scale, resistivity, etc.) of the washed sand.

Note: *As a reference, the surface potential of bulk tank to be protected shall be more negative than -0.85 volt with reference to a copper/copper sulphate*

(Cu/$CuSO_4$) electrode or more negative than +0.25 volt with reference to a zinc electrode. The cathodic protection specialist may apply other performance criteria in accordance with NACE SP-0285 when appropriate.

5.2.4 Pressure Relief Valve for Bulk Tank

5.2.4.1 Each bulk tank shall be fitted with pressure relief valve(s) which is set in accordance with a relevant pressure vessel code to which the bulk tank is designed. The pressure relief valve shall have the following information stamped on the valve or on a separate metal plate securely fixed to it:

a) the manufacturer's identification including name and catalogue or type number; and
b) the pressure at which the valve starts to discharge the product.

Extra space shall be provided on the valve or the metal plate for subsequent stamping of periodic retest dates.

5.2.4.2 For multi-port pressure relief valves, any provision made for isolating any relief valve for testing or servicing shall ensure that the remaining relief valves connected to the bulk tank are of the same full flow capacity.

For bulk tanks fitted with a single pressure relief valve, provision shall be made for its removal for testing or servicing by means of an automatic shut-off valve, provided that the shut-off valve is retained in the fully open position by the presence of the relief valve and closes before the relief valve is completely removed. A replacement relief valve shall be fitted immediately so as not to have the bulk tank left unprotected.

5.2.4.3 Pressure relief valves shall be of a direct spring-loaded type or equivalent, be tamper-proof and be constructed in such a way so that breakage of any part shall not in any way lessen the relief function.

The outlet of a relief valve shall be piped individually to a safe location away from the bulk tank so as to prevent flame impingement on the bulk tank or any adjacent bulk tank, pipework or equipment. Relief valves shall be fitted with vent pipes adequately supported and having outlets at least 3 m above ground level and 2 m above the top of the bulk tank to which they are fitted. The bore of these vent pipes shall be sufficiently sized for the full flow characteristics of the relief valves. Each vent pipe outlet shall be suitably identified and provided with a rain cap to prevent ingress of rain water.

There shall be no fixed electrical installations in the direct path of discharge of relief valve vents. For separation distances from building openings and source of ignition, refer to Clause 4.1.3.7.

5.2.4.4 For underground and mounded bulk tanks, the full flow capacity of the pressure relief valves shall be sized in accordance with the following formula:

$$A = 3.1965\ S^{0.82}$$

Where S (Surface) = total exterior surface-area of the tank in m^2

A (Air Flow) = air to be allowed to escape at 15°C and atmospheric pressure in m^3/min

5.2.4.5 For aboveground bulk tanks, the full flow capacity of the pressure relief valves shall be 3.33 times the values as determined by the above formula.

5.2.5 Filling Level and Content Gauge

5.2.5.1 Bulk tanks shall be filled in accordance with Gas Safety (Gas Supply) Regulation 10 which states that the bulk tanks shall not be full of LPG at a temperature of 52.5°C and not more than 97% full at 47.5°C. As a rule of thumb, bulk tanks should not be filled more than 85% of the tank volume. At particular LPG compounds, this may be dictated otherwise by the conditions of construction approval / approval of use specific to the LPG compound to be even less.

5.2.5.2 Each bulk tank shall be equipped with at least two gauges for indicating the quantity of content, one of which shall be of a fixed liquid level type. The contents gauges shall clearly indicate the contents in % of the tank volume.

5.2.5.3 Permanent marking plate shall be provided for the maximum percentage of volumetric capacity that the bulk tank is to be filled under any circumstances.

5.2.6 Inspection Hole and Other Connections

5.2.6.1 Bulk tanks shall have a manhole or an inspection port for internal inspection. The manhole shall have a minimum diameter of 450 mm for bulk tanks exceeding 5,000 litres water capacity. For bulk tanks with manholes in the form of extended nozzles, the manhole diameter shall not be less than 550 mm. For underground or mounded bulk tanks, all fittings shall be accessible from aboveground level.

5.2.6.2 Liquid and vapour connections on bulk tanks other than those for pressure relief valves, plugged openings and those where the outlet from this connection through the bulk tank shell is not greater than 1.4 mm (No. 54 Morse Drill size), shall have fire resistant shut-off valves capable of manual operation located as close as practicable to the bulk tank. Pipe extensions or other fittings shall not be installed between the connections and the valves unless the pipe extensions or fittings are designed, manufactured, examined and tested to the tank's design code and certified by a Class 1a Competent Person.

Note: *A fire resistant valve is a valve that would substantially retain fluid under specified temperature conditions. BS EN 10497 and API 607 give guidelines on fire test for valves.*

5.2.6.3 An excess flow valve or check valve shall be installed in all liquid connections larger than 3.0 mm and in all vapour connections larger than 8.0 mm with the exception of openings for pressure relief valves. Excess flow valves shall be installed inside the tank opening to safeguard its function if the connection is broken outside the

bulk tank. The normal closing flow rate of an excess flow valve shall be greater than the anticipated maximum flow rate so as to prevent premature closing.

5.2.6.4 The fill-connection of bulk tank(s) at the point of the connection with a road tanker shall be equipped with a double check filler valve and a manual shut-off valve.

5.2.6.5 Bulk tanks shall be provided with a drain connection for removing sediment and water contents. The drain connection shall be fitted with a shut-off valve not more than 25 mm nominal diameter. The outlet shall be blanked or plugged.

5.2.6.6 Pressure gauges shall be provided and be connected to the vapour space of the bulk tank and shall be located in such a way so that the dial gauge can be read from above the ground level. Pressure gauge connections shall be protected either by a tapping reduced internally to a bleed hole not larger than 1.4 mm diameter or by a suitable excess flow valve and shut-off valve.

5.2.6.7 Temperature gauges, where fitted, shall be installed in blind pockets. The pockets shall be in the form of blind tubes of suitable length and strength, oil filled, permanently welded to the bulk tank and constructed in accordance with the corresponding bulk tank design code.

5.2.6.8 Pipework and fittings on bulk tanks shall be suitably protected against mechanical damage.

5.2.7 Emergency Shut-off Valves

5.2.7.1 Emergency shut-off valves are for the purpose of isolating the tank contents when an emergency occurs, thus preventing the largest source of hazard from being released.

5.2.7.2 Emergency shut-off valves shall be installed in the liquid line between storage tank and vaporiser. Consideration should be given to installing it in the vapour line coming out of the tank as well.

5.2.7.3 Emergency shut-off valves shall have all the following features:

a) Capable of local activation.

b) Capable of remote activation from a safe location outside the LPG compound.

c) Have a temperature closing element that operates at a maximum temperature of 120^{O}C.

5.2.8 Other Special Features

5.2.8.1 To further mitigate the risk of gas leakages when the bulk tank plant is unattended, consideration should be given to the installation of flammable gas detectors linked to motor operated valves (MOVs) to isolate bulk tank contents. The design of the system should take into account the reliability of the system, so that it will not cause inadvertent closure of the MOVs causing undue gas interruptions. (See Appendix M for reference).

5.3 Piped-cylinder Stores

5.3.1 General

5.3.1.1 A piped-cylinder store may have cylinders supplying LPG either in liquid or gaseous form to a manifold system.

5.3.1.2 Typical schematic diagrams are shown in Appendix E.

5.3.2 Flexible Gas Tubing (Pigtail)

5.3.2.1 A pigtail connecting each cylinder to a manifold system shall not be left unconnected and be protected from direct sunlight.

5.3.2.2 Pigtails shall be manufactured according to recognised engineering standards or codes. If wire braid is used for reinforcement, it shall be of corrosion resistant material such as stainless steel. Records of relevant inspections and testing certificates shall be maintained.

5.3.2.3 Pigtails shall be designed to withstand a minimum bursting pressure of 4 times the maximum working pressure. Each pigtail shall be marked with "LPG" and be tagged with a label indicating the date of next replacement.

5.3.2.4 Each pigtail coupling shall be incorporated with a self-closing valve to prevent leakage of LPG from the pigtail during disconnection from an LPG cylinder.

5.3.3 Safety Devices

5.3.3.1 Provision shall be incorporated into a manifold system to ensure that failure of a pigtail connecting a cylinder to the manifold will not cause the complete loss of content from other cylinders.

5.3.3.2 When an LPG installation with more than one cylinder supplies LPG to a piped gas system by means of pigtails to a manifold system, appropriate safety devices shall be incorporated in accordance with Gas Safety (Gas Supply) Regulation 11(e) as described in Section 5.3.3.3.

5.3.3.3 The device consisting of a stop valve with check function shall be installed between the pigtail and the manifold system for all cylinders. In the case of liquid withdrawal cylinders, one particular cylinder of each bank shall be installed with a stop valve with excess flow device to allow liquid LPG to flow back from the vaporiser.

5.3.4 Change-over Devices

5.3.4.1 A change-over device shall be installed for a piped-cylinder store between two banks of cylinders, one for regular supply and the other for reserve.

5.3.4.2 The operation of the change-over device shall avoid GAS ON - GAS OFF - GAS ON situation, and shall have suitable means of indication for gas flow direction.

5.3.4.3 By-pass pipework in addition to change-over device may be provided to ensure continuity of supply during maintenance. By-pass valves shall be kept closed throughout the normal operation.

Note: *For change-over devices with pressure regulating function, when using the by-pass pipework, the downstream regulators or equipment shall be checked to see if the supply pressure is within their design operating limits.*

5.3.4.4 To enhance the reliability of gas supply and minimise the risk of gas outage, for installations where the gas consumption pattern is irregular (e.g. industrial / commercial systems), or where gas storage quantity is small compared to gas consumption (e.g. temporary piped-cylinder store during single LPG tank revalidation period), consideration should be given to an add-on device which can send a signal to alert the gas supply company for replenishment when the regular supply bank has been used up.

5.3.5 Piped-cylinder Store for Temporary Supply During Tank Revalidation

5.3.5.1 At LPG compound where one LPG tank is temporarily decommissioned for revalidation, a temporary piped-cylinder store should be installed as a stand-in gas supply, or to back up gas supply due to the reduced storage capacity.

5.3.5.2 Construction approval and approval of use from the Gas Authority shall be required for the temporary piped-cylinder store.

5.3.5.3 The temporary piped-cylinder store should be constructed wholly within the LPG compound. Safety distances and other siting and safety requirements shall be as per a normal cylinder store (refer to Section 4.2).

5.3.5.4 As the temporary piped-cylinder store is entirely within the confines of the LPG compound, no additional perimeter fence is required. However, a roof shall be required above the cylinders, as per Section 4.2.1.13, for shielding the pigtails from direct sunlight.

5.3.5.5 On cessation of operation of the temporary piped-cylinder store, the system shall be properly decommissioned, gas freed and dismantled (refer to Section 12), and the Gas Authority shall be notified for cancellation of the installation.

5.4 Vaporisers

5.4.1 General Requirements

5.4.1.1 Vaporisers capacity shall be adequate for meeting expected maximum gas demand. For multiple vaporisers installations serving large number of customers, to minimize the risk of gas supply interruption, consideration should be given to provide vaporisers on a “n + 1” basis, where n is the number of vaporisers required to meet maximum expected gas demand.

5.4.1.2 Electric vaporisers shall be of flameproof type. They can be of water baths type, or dry type where the heating elements are embedded in the metal core which acts as the heat transfers medium.

5.4.1.3 Pressure containing components of vaporisers shall be designed in accordance with a recognised pressure vessel code or a code specified for vaporiser. The design pressure of the pressure containing components shall meet the highest pressure and temperature in service and shall not be lower than the set pressure of the pressure relief valve.

5.4.1.4 Electrical wiring and lighting for vaporiser rooms shall be designed and constructed to be suitable for the hazardous area classification as per Appendix F.

5.4.1.5 For remote fired boiler type vaporisers, the following shall be complied with:

a) The heat transfer fluid shall be non-flammable.

b) Gas fired boilers shall be equipped with automatic safety device to shut off gas to the main burners if ignition fails to occur.

c) The boiler shall be situated at least 4.6m from the vaporiser (refer to Section 4.3.4).

d) If the heat transfer fluid is recirculated after leaving the vaporiser, the following applies: -

(i) The boiler shall be located in a building that complies with the requirements of a cylinder store.
(ii) A phase separator shall be installed for the heat transfer fluid recirculating system, and the gas vented in accordance with the requirements of a PRV vent.

5.4.1.6 A metal plate securely fixed to the outside of each casing shall be permanently marked with the following information:

a) manufacturer and the serial number;
b) date of manufacture;
c) design code;
d) vaporising capacity; and
e) maximum working pressure and design temperature.

Extra space shall be provided on the metal plate for subsequent periodic marking of retest dates.

5.4.1.7 Heating coils shall not be installed inside bulk tanks as a means of vaporisation.

5.4.1.8 Every liquid or vapour line fitted to a vaporiser shall be provided with a shut-off valve located as close as practicable to the vaporiser in accordance with Gas Safety (Gas Supply) Regulation 13.

5.4.1.9 Pressure regulating and other equipment downstream of a vaporiser shall be designed for the pressure output of the vaporiser and the maximum discharge temperature of LPG.

5.4.1.10 For bulk tank installation, emergency shut-off valves upstream of the vaporisers shall be installed in a prominent location outside of the vaporiser room for easy access and operation under emergency conditions. For detailed requirements on emergency shut-off valves, refer to Section 5.2.7.

5.4.1.11 Drain connection shall be provided to the vaporiser with a shut-off valve to allow for removal of heavy ends. The connection shall be blanked or plugged.

5.4.2 Pressure Relief Valve for Vaporiser

5.4.2.1 Vaporiser shall be fitted with a pressure relief valve in direct communication with the vapour space which is set to relieve in accordance with the recognised pressure vessel code or the code specified for vaporiser to which the vaporiser is designed and constructed. The relief capacity shall be 3.33 times the values as determined by the formula in Section 5.2.4.4, using the surface area of the vaporiser shell and that of the heat exchanger that is directly in contact with LPG as the total surface area. Valve identification shall be provided in accordance with Section 5.2.4.1.

5.4.2.2 Pressure relief valves shall be of a direct spring-loaded type or equivalent, be tamper-proof and be constructed in such a way so that breakage of any part shall not in any way lessen the relief function.

5.4.2.3 For vent pipe arrangement, see Section 5.2.4.3.

5.4.3 Heat and Liquid Controls

5.4.3.1 Heat input shall be controlled by a suitable thermostat to prevent the pressure in the vaporiser from reaching the set pressure of the relief valve.

5.4.3.2 Vaporiser with water as heating medium shall be controlled by thermostat for regulating the water temperature. It shall include a means of water level indication and low water level cut-off if the water level drops below certain set level.

5.4.3.3 Large vaporiser with several heating elements may be controlled in stages by more than one thermostat for regulating the temperature.

5.4.3.4 Vaporiser shall be provided with an automatic control valve of a suitable type (e.g., thermostatic control coupled with magnetic valve, or float valve) to prevent liquid LPG from passing through the vaporiser.

5.5 Pressure Regulators

5.5.1 Design Criteria

5.5.1.1 In general, a piped gas supply system shall consist of primary and secondary pressure regulators, which shall be designed in accordance with Gas Safety (Gas Supply) Regulation 21 in order to achieve the following objectives:

a) ensuring reliable and continuous supply of LPG;
b) protecting downstream system against over-pressure and under-pressure; and
c) protecting against failure of any single regulating device causing a hazardous situation.

5.5.2 Primary Pressure Regulator

5.5.2.1 An active and monitor regulator system with two regulators installed in series shall be provided for supplying LPG to multi-users. The upstream monitoring regulator shall be set marginally higher than that of the downstream active regulator.

5.5.2.2 A cascade system or parallel regulators system consisting of active and monitor pressure regulators should be considered for an installation with large LPG consumption.

5.5.2.3 For a single user, one regulator may be used for primary pressure regulation.

5.5.2.4 The normal operating pressure for a domestic distribution system after primary regulators shall be 69 kPa (10 psig) maximum.

5.5.2.5 Valves shall be provided in such a way so that regulators may be accessible for servicing and maintenance.

5.5.2.6 A vapour line with suitably sized regulators shall be installed to supply gas direct from the vapour space of the bulk tanks as a back up to the gas supply stream from the vaporisers.

5.5.2.7 Provision of an additional by-pass line may be incorporated to facilitate the maintenance of primary regulators. Unless the by-pass line is properly terminated with valves and plugged, it shall be provided with a suitably sized regulator with overpressure shut-off function.

5.5.2.8 A main control valve shall be installed on the vapour line downstream of the primary regulators for termination of gas supply to consumers in the event of an emergency (see Section 4.1.2.7).

5.5.2.9 Pressure gauges of suitable range shall be installed for indicating conditions of the regulators.

5.5.2.10 Sensing pipework required for primary regulators shall be of solid drawn copper tubes in accordance with BS EN 12449 or equivalent, but suitable corrosion-resistant steel tubes are acceptable provided that they are connected with suitable proprietary fittings.

5.5.2.11 Sensing pipework shall be routed in such a way so as to eliminate excess bending or fracture due to impact.

5.5.3 Secondary Pressure Regulator

5.5.3.1 Secondary regulators may be installed inside the LPG compound or piped-cylinder store.

5.5.3.2 For locations where continuity of gas supply is critical, consideration should be given to installing a parallel stream of secondary regulators to facilitate maintenance and inspection.

5.5.3.3 Secondary regulator shall include overpressure and underpressure protections.

5.5.3.4 The downstream pressure from secondary regulator shall not exceed 6.9 kPa (1 psig) for supplying gas to domestic users.

5.6 Pipework and Fittings

Note: *See also Gas Safety (Gas Supply) Regulation 17 for general statutory requirements for pipework. For the purpose of this Module, Regulations 17(1), (2), (3), (5) and (7) are relevant.*

5.6.1 Pipework within LPG compounds and cylinder stores should preferably be run exposed and aboveground as far as practicable. It shall be routed away from or protected against excessive heat or cold. Pipework may also be buried underground if circumstances require (e.g., when necessary for crossing driveway, passing underneath obstructions, etc.).

5.6.2 Pressure gauges or plugged test points shall be provided at various strategic points of the pipework system for operational use or commissioning. Pressure gauges shall not be provided on liquid LPG pipework except pumping facilities.

5.6.3 Electrostatic precautions shall be in accordance with the requirements stated in Section 7.2.

5.6.4 Pipework passing through walls and/or floors shall be sleeved and sealed properly with suitable corrosion protection materials.

5.6.5 Pipework layout and supports shall be provided with adequate allowance to accommodate any movement that may occur due to thermal expansion or contraction of LPG pipework. Distance between pipe supports for vertical and horizontal pipe sections within LPG compounds and cylinder stores shall be in accordance with Table 5-1.

Table 5-1
Support Spacing for Aboveground Pipework

Nominal size (mm)	Maximum spacing	
	Vertical (m)	Horizontal (m)
20	3.0	2.5
25	3.0	2.5
32	3.0	2.7
40	3.5	3.0
50	3.5	3.0
80	4.5	3.0
100	4.5	3.0
150	4.5	3.0
200	4.5	3.0

5.6.6 High pressure pipework (before primary regulator) shall be of seamless steel conforming to ASTM A53, BS EN 10216 or equivalent.

5.6.7 Medium pressure pipework (after primary pressure regulator), low pressure pipework (after secondary pressure regulator) and vent pipes shall be of heavy grade steel conforming to BS EN 10255 or equivalent.

5.6.8 When high pressure pipework is installed underground, it shall be of all welded construction to reduce the chance of leakage and shall be suitably protected against corrosion by means of external coating and tape wrapping.

5.6.9 Steel flanges and flanged fittings shall conform to ANSI B16.5, BS 1560 or equivalent and bolting arrangement to BS 4882 or equivalent. The number of flanged joints should be kept to a minimum as a good practice.

5.6.10 Use of cast-iron pipe shall not be permitted.

5.6.11 Pipe joints up to and including 50 mm nominal diameter may be threaded. Threaded high pressure pipes and fittings shall be of heavy wall thickness of Schedule 80 (BS 1600 or equivalent) and be of the same tapered form. Threaded medium and low pressure pipework shall be of heavy grade steel to BS EN 10255 or equivalent.

5.6.12 Steel socket-welded and screwed fittings and screwed couplings shall be in accordance with BS 3799 or equivalent.

5.6.13 Butt-welded fittings shall be forged seamless steel.

5.6.14 Hydrostatic pressure relief valve (HPRV) shall be fitted between any pipe sections where liquid LPG can be trapped (e.g., sections between shut-off valves and blank flanges, pumps between closed suction and discharge valves, etc.) in order to accommodate any thermal expansion.

5.6.15 HPRV should have a pressure rating at a range of 2.4 MPa (350 psig) to 2.75 MPa (400 psig) and shall not be higher than the weakest element in the system.

5.6.16 Valves shall be installed at accessible locations for ease of operation and maintenance.

5.6.17 Manual shut-off valves fitted onto the liquid and vapour outlet connections of a bulk tank shall be of a fire-resistant type (see Section 5.2.6.2).

5.6.18 Each LPG compound or piped cylinder store shall have a main control valve for shutting off the LPG supply from the compound / cylinder store under emergency conditions. It shall be located at a prominent position, suitably marked, and easily accessible under emergency conditions. See also Section 4.1.2.7 for further requirements.

5.7 Drain Connections

5.7.1 This Section applies to bulk tanks and vaporisers.

5.7.2 The outlet of the drain valves should be provided with a length of pipe terminating with a second shut-off valve. The length of pipe shall be such that the risk of simultaneous freezing of the two valves is minimised. The upstream valve shall be a quick action quarter-turn valve, and the downstream valve shall be a globe valve for easy throttling and control.

5.7.3 The second valve and associated pipework shall be adequately supported and secured to prevent mechanical damage.

5.7.4 Valve control handles shall be securely fixed to the drain valves to ensure that the valves can be closed instantly.

5.7.5 The second valve may be fitted permanently where appropriate. In this case, the outlet of the second valve shall be blanked or plugged when not in use.

5.7.6 No drain shall discharge into or be in the proximity of any public or other drainage system where this would be liable to create a hazard.

5.8 Ventilation and Explosion Relief

5.8.1 General

5.8.1.1 The design of LPG installations (e.g., LPG compounds, cylinder stores and vaporiser rooms, etc.) shall be such that the occurrence of a build-up of an LPG /air mixture above the lower explosive limit is minimised by the provision of adequate ventilation, but should such a build-up occur and ignition take place, the consequences of such an incident to the surrounding environment shall be minimised by the provision of adequate explosion relief.

5.8.1.2 LPG installations shall be constructed with non-combustible materials. A heavy duty wire mesh structure with a light roof for weather protection is acceptable.

Where a rigid concrete structure is necessary, it shall be designed to provide maximum ventilation and explosion relief.

5.8.1.3 Walls, ceiling, roofs and doors (including door frame and hinge assembly) shall be designed such that if imperforated, they shall be capable of withstanding a static pressure of at least 4.8 kPa.

5.8.1.4 Where wire meshes are used for ventilation, they shall be of grid sizes not less than 5 mm.

5.8.2 Natural Ventilation

5.8.2.1 LPG installations shall be ventilated utilising air inlets and outlets arranged to provide air movement across the floor as uniformly as practical and in accordance with Sections 5.8.2.4 - 5.8.2.7.

5.8.2.2 Ventilation apertures shall be positioned in such a way so as to prevent accumulation of LPG.

5.8.2.3 LPG cylinders and/or equipment shall not be located within 150 mm of ventilation apertures. Suitable measures shall be taken to prevent blockage of ventilation apertures.

5.8.2.4 Apertures for ventilation shall be situated in external walls of LPG installations such that:

a) the bottoms of low level ventilation apertures are not more than 150 mm above the floor;

b) the tops of high level ventilation apertures are not more than 500 mm below the ceiling;

c) the effective low level ventilation area is within 500 mm from the floor; and

d) the effective high level ventilation area is within 1,000 mm from the ceiling.

5.8.2.5 Where 4 walls, 3 walls or only 2 opposite walls are used for ventilation, apertures shall be provided having a total effective area of at least 0.014 m^2 per m^2 of floor area at low level and 0.007 m^2 per m^2 of floor area at high level.

5.8.2.6 Where only 2 adjacent walls are used for ventilation, apertures shall be provided having a total effective area of at least 0.02 m^2 per m^2 of floor area at low level and 0.01 m^2 per m^2 of floor area at high level.

5.8.2.7 A single ventilated wall may only be used for ventilation if all the following criteria are met:

a) The width of the ventilated wall is at least 1.5 times of the depth of the LPG installation to be ventilated.

b) The depth of the LPG installation to be ventilated does not exceed 2.5 m.

c) Apertures are provided having a total effective area of at least 0.03 m^2 per m^2 of floor area at low level and 0.015 m^2 per m^2 at high level.

5.8.3 Mechanical Ventilation

5.8.3.1 Where all the natural ventilation criteria cannot be met, mechanical ventilation may be considered. The ventilation system should meet the following criteria:

a) The mechanical ventilation system shall be exclusively for the LPG installation, independent of other ventilation systems for other parts of the building.

b) The rate of air circulation shall be at least 0.3 m^3 /min/m^2 of floor area.

c) The air flow velocity at air duct inlet openings shall be at least 5 m/s.

d) The bottom edge of air duct inlet openings shall not be more than 150mm from the floor.

e) LPG cylinders and/or equipment shall not be located within 150 mm of air duct inlets. Suitable measures shall be taken to prevent blockage of these inlets.

f) Air duct discharge outlets shall be at least 1.5m from openings of the LPG installation or any other structure.

5.8.3.2 Electrical equipment and wiring for the mechanical ventilation system shall be designed and constructed to be suitable for the hazardous area classification as per Appendix F. It should be noted that the mechanical ventilation system is extracting air from inside the LPG facility, which itself is a classified hazardous area. Therefore, the air flow path within the ventilation air duct carries the same hazardous area classification as the room interior.

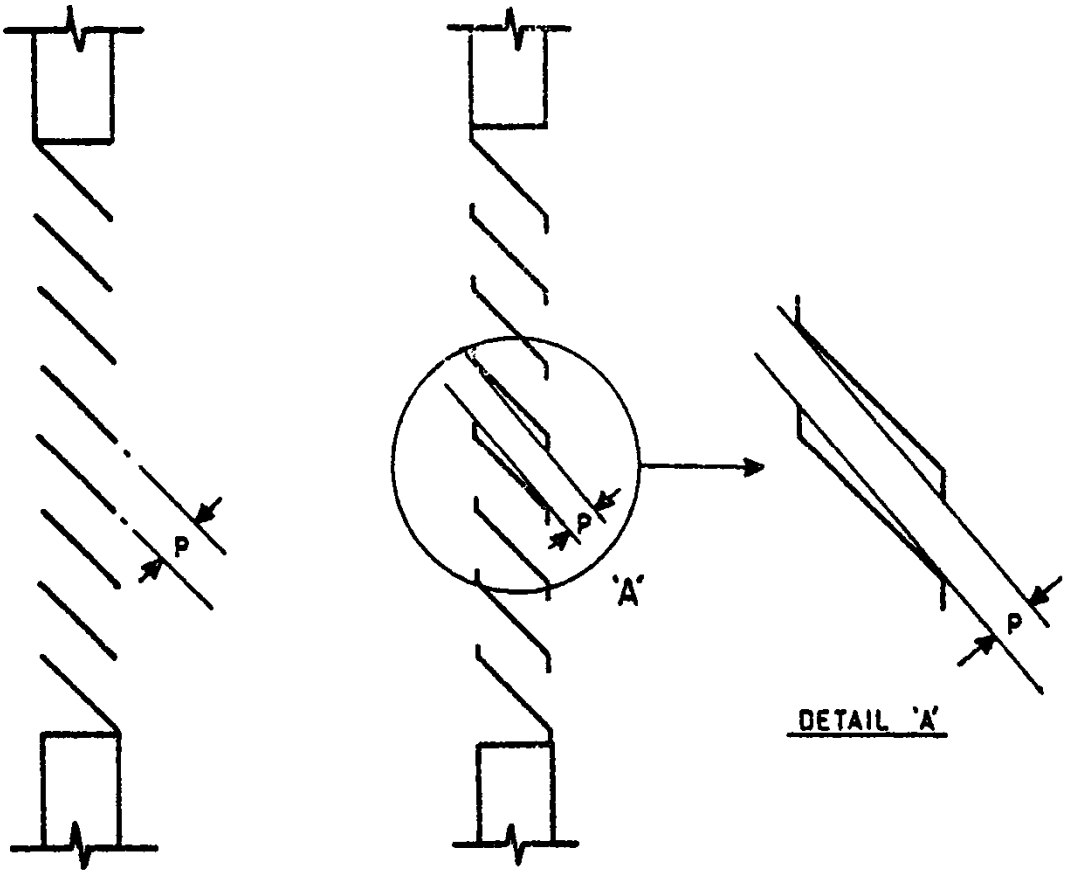
5.8.3.3 A flammable gas detection system should be installed inside the LPG store. If gas leakage is detected, an alarm signal should be generated and relayed to the NGI owner.

5.8.4 Explosion Relief

5.8.4.1 LPG installations shall be provided with explosion relief apertures located in external walls, the explosion relief area shall be at least 0.07 m^2 per m^3 of enclosed volume for open vents, or at least 0.1 m^2 per m^3 of enclosed volume for louvred vents. A louvred angle shall not be in excess of 45° to the horizontal. The method for calculating the “effective area of ventilation/explosion relief” is shown in Figure 5.

5.8.4.2 Imperforated explosion relief panels shall not be used.

5.8.4.3 Ventilation apertures may be included as explosion relief apertures.



Effective Area = p x n x w

where p = unobstructed pitch between louvres
n = number of louvred apertures (7 in above examples)
w = width of louvred opening

Figure 5
Calculation of Effective Area for Louvres

SECTION 6 FIRE PRECAUTIONS

6.1 LPG storage sites shall be maintained regularly to prevent overgrown vegetation, and storage of combustible and irrelevant materials.

6.2 LPG compounds, cylinder stores and vaporiser rooms shall be equipped with fire extinguishers of dry powder type at suitable locations in accordance with Table 6-1.

6.3 Fire extinguishers shall be replaced or revalidated annually, and marked conspicuously with the last test date.

6.4 Provision of fire fighting facilities shall comply with the requirements of the Fire Services Department as appropriate.

Table 6-1
Minimum Number of Fire Extinguishers Required
for LPG Compound, Cylinder Store and Vaporiser Room

LPG Storage Capacity (Tonnes)	Minimum Number of Fire Extinguishers Required
LPG Compound (excluding vaporiser room)	
Up to 25 Above 25	2 3
LPG Cylinder Store (excluding vaporiser room)	
Up to 1 1 - 2.5 Above 2.5	1 2 3
Vaporiser room	1

6.5 All other additional fire services requirements formulated by Fire Services Department through central processing of building plans via Buildings Department shall be complied with.

SECTION 7 ELECTRICAL REQUIREMENTS AND ELECTROSTATIC PRECAUTIONS

7.1 Electrical Requirements

7.1.1 Hazardous Area Classification

Area classification is dependent on the probability of a hazardous atmosphere being present, i.e., an atmosphere containing a significant quantity of flammable gas mixture capable of being ignited. It is defined as the following zones:

Zone 0 - An area in which a flammable gas-air mixture is continuously present in normal operation.

Zone 1 - An area in which ~~a~~ flammable gas-air mixture is likely to occur in normal operation.

Zone 2 - An area in which a flammable gas-air mixture is not likely to occur in normal operation, and if it occurs it will only exist for a short time.

Non-hazardous or safe area - An area which is not classified as Zone 0, 1 or 2.

7.1.2 Electrical Equipment

7.1.2.1 Electrical equipment should be located in safe or non-hazardous areas.

7.1.2.2 Electrical equipment for use in and around LPG installation (see definitions in Section 7.1.1) shall be certified with stamped markings for the intended use (i.e., appropriate classified zone, gas group and temperature classification) in accordance with EN 60079 or equivalent. Special provision is made for tank cathodic protection measurement box situated inside valve assembly chamber (see Appendix F).

7.1.2.3 Selection and installation of electrical equipment for use in hazardous areas shall be generally in accordance with the recommendations of EN 60079 or equivalent (see Appendix F). References may also be made to the EI Model Code of Safe Practice, Part 1.

7.1.2.4 Electrical equipment for use in classified zones shall be in accordance with ATEX or IEC requirements or equivalent. The following provides a reference:

Hazardous Zone	EPL	ATEX	Type of Protection (in accordance with EN 60079)
0	Ga	1G	Ex ia or Ex ma
1	Gb	2G	Ex d; Ex e; Ex i; Ex m; Ex p; Ex o; Ex q
2	Gc	3G	Ex n

Note: *All equipment types suitable for a higher zone is automatically suitable for a lower zone.*

7.1.2.5 Electrical equipment shall have a temperature class of T2 or higher (i.e., a lower maximum equipment surface temperature).

7.1.2.6 All electrical wiring and cables for use in classified zones shall be certified by the manufacturer as being suitable for its intended use.

7.1.2.7 If the electrical equipment used outdoors, if necessary, within a zone 2 area, the degree of ingress protection (IP) rating shall be 54 or higher.

7.1.2.8 Fixed electrical installations having any approved loading at the LPG compounds and cylinder stores (i.e., LPG storage installation) are required to be inspected, tested and certified at least once every year by an electrical worker / contractor registered under the EMSD. The NGI owner shall keep the work completion certificate (Form WR1) and periodic test certificate (Form WR2) as formal records. The competent person class 2 will inspect the Form WR2 during the annual inspection and record in the annual inspection report (Form 109).

7.2 Electrostatic Precautions

7.2.1 Underground and mounded bulk tanks and LPG pipework with cathodic protection systems should not be earthed normally, and outlet connections shall be electrically insulated from the downstream pipework by means of suitable insulation flanges.

Note: *Existing aboveground bulk tanks shall be electrically earthed to protect against accumulation of static electricity*.

7.2.2 Means should be provided to ensure that no electrostatic potential exists between the road tanker delivery connection and the tank fill connection which could cause a spark when these connections are either made or broken.

7.2.3 An earthing point should be provided at tanker bay for discharging static electricity from road tankers. Earthing points for dissipation of static electricity should have an electrical resistance to earth of not greater than 1×10^6 ohms.

7.2.4 Aboveground pipework and fittings downstream of the insulation flanges shall be bonded to earth.

7.3 Power Supply Monitoring

7.3.1 For LPG compounds supplying 500 consumers or above, consideration should be given to the installation of a power supply monitoring system, so that power supply interruption affecting gas supply can be tackled in time. This should consist of a device to continuously monitor the power supply situation, and send an alarm message to the gas supply company when power supply interruption is detected.

SECTION 8 INSTALLATION

8.1 General

8.1.1 Construction approval from the Gas Authority shall be obtained prior to carrying out any installation work of LPG compounds or cylinder stores (see Section 3.1).

8.1.2 Installation work shall be in accordance with the approved drawings and design requirements as stated in this Module.

8.1.3 Installation work shall be carried out by Gas Systems Contractors with appropriate class of Competent Person employed.

8.1.4 LPG installations shall not be used to contain any LPG unless approval of use is obtained from the Gas Authority (see Section 3.1), and that they are commissioned in accordance with the requirements of Section 9.

8.1.5 Installation sites shall be suitably prepared prior to delivery of equipment and commencement of installation work.

8.2 Bulk Tanks

8.2.1 Each bulk tank shall be holiday and paint thickness tested (400 μm minimum, or as specified by the paint manufacturer) over its entire surface and any defects found shall be repaired and retested before burying the tank.

8.2.2 The bulk tank shall be installed on firm foundation and shall be secured at both ends against flotation.

8.2.3 Extreme care shall be taken when transporting and handling bulk tanks to prevent them from accidental damage to the coatings.

8.2.4 Extreme care shall be taken to avoid electrical contact between the bulk tank and any steelwork associated with the anchoring system unless included in the cathodic protection system.

8.2.5 Pressure relief valves installed on the bulk tank shall be obtained from a manufacturer accepted by the Gas Authority. Pressure relief valves shall be tested by the manufacturer before shipment. A manufacture / test date properly stamped by the manufacturer is deemed to be valid proof that the pressure relief valve has been properly tested. The pressure relief valves installed on the bulk tank shall not, at the time of installation, be older than 24 months from the date of manufacture; otherwise, the renewal date shall be counted from the date of manufacture. For the convenience of tracking the 5-yearly replacement, a tag should be affixed to each pressure relief valve showing the next due date for replacement.

8.3 Cathodic Protection

8.3.1 Anodes shall be so placed in washed sand that they are free from any possible contact with other objects.

8.3.2 Reference electrodes shall be installed and terminals provided for testing of the cathodic protection system.

8.3.3 Care shall be taken during backfill to prevent damage to the wiring of the system and undue strain on the electrical connections.

8.3.4 The end of the test wires shall be installed in a weatherproof test box at ground level and be suitably identified.

8.3.5 When installing an earthing system, care shall be taken not to interfere with the cathodic protection system.

8.3.6 As-built drawings and records of the cathodic protection system shall be made after installation and shall include the following data:

a) quantity, type, size and location of anodes;
b) date of installation and commissioning;
c) type of backfill material; and
d) resistivity measurement of electrolyte.

These records and subsequent periodic testing results shall be maintained for the service life of the bulk tank.

8.4 Vaporisers

8.4.1 Vaporisers shall be installed in accordance with manufacturers' instructions. Care shall be taken to ensure that vaporisers are adequately supported without undue strain on the associated pipework.

8.4.2 The section of high pressure vapour pipeline between vaporisers and first stage regulators shall be kept to a minimum. This is to minimise the chance of re-condensation of the high pressure vapour in cold weather. This section of pipeline shall be sloped back towards the vaporiser, so that should there be any re-condensation, the liquid will flow back to the vaporiser rather than to the downstream pipework.

8.4.3 Pressure relief valves, pressure regulators and control equipment installed at/near the vaporiser shall not be located at where the ambient temperature is in excess of 60°C unless they are specifically designed for higher temperatures.

8.4.4 The outlet of drain valves shall be blanked or plugged when not in use.

8.4.5 Vaporiser shall be equipped with a pressure gauge at the vaporiser outlet. In the case of a water-heated vaporiser, means for temperature and water level indication shall be provided accordingly.

8.4.6 The pressure relief valve of each vaporiser shall be piped upwards individually and its vent outlet shall be directed away in a safe manner from other vaporisers and/or bulk tanks. The vent pipe shall be designed and constructed for the full flow capacity of the pressure relief valve.

8.5 Pipework and Fittings

8.5.1 LPG pipework shall be of welded construction as far as practicable. Welded joints shall be fabricated in accordance with relevant design and welding standards.

Note: *Liquid Gas UK Code of Practice No.22, NFPA 58 or equivalent are applicable.*

8.5.2 Shut-off valves shall be installed to enable isolation of equipment and between lengths of pipework. An HPRV shall be fitted to each liquid pipe section that can be isolated.

8.5.3 Before installation, all fittings and pipe sections shall be inspected and cleaned inside to ensure absence of dusts, grease, rust and foreign matters. During installation, precautions shall be taken to prevent pipe connections from contamination. Exposed threads after connection shall be immediately treated and coated against corrosion.

8.5.4 Before installation of pressure regulators, their dust caps, transit locking pins, etc. shall be removed, and the orientation and correct direction of flow determined. Pressure regulators shall be adequately supported and oriented in accordance with the manufacturer's instructions.

8.5.5 All aboveground pipework shall be adequately protected against mechanical or vehicular damage, adequately supported and suitably protected against corrosion by painting, galvanising or coating. Exposed pipework containing liquid LPG shall be suitably colour coded in blue with the word “Liquid” marked on the surface at conspicuous intervals. Exposed pipework containing LPG vapour shall be suitably colour coded in yellow with the word “Vapour” marked on the surface at conspicuous intervals.

8.5.6 Underground LPG pipework, if used underneath driveway in LPG compounds / piped cylinder stores, shall be protected against likely mechanical or vehicular loads by laying at a minimum depth of 1 000 mm below ground level, with continuous yellow plastic marker tape provided 100 to 300 mm above the pipe. If the minimum depth of 1 000 mm cannot be met due to site constraints, concrete slabs not less than 40 mm thick or steel plates not less than 3 mm thick at a height of 100 to 300 mm above the LPG pipe can be used to protect it against damage. The protective slab or plate shall project at least 100 mm on either side of the pipe.

8.5.7 Underground pipework should be wrapped with protective tape against corrosion. Wrapping should preferably be done before laying the pipe sections into the trench, so that adequate working space is allowed for proper wrapping.

8.5.8 The discharge outlet of HPRV shall be positioned towards ventilated areas and shall not be directed towards persons, bulk tanks or equipment. If the discharge outlets of HPRV need to discharge to an unventilated area, a risk assessment shall be conducted to determine the hazardous zone classification of that area. To reduce the risk of blockage, the HPRV inlet connection should not be on the underside of pipework.

8.5.9 HPRV shall be protected by means of rain cap.

8.5.10 HPRVs installed on the pipework shall not, at the time of installation, be older than 24 months from the date of manufacture; otherwise, the renewal date shall be counted from the date of manufacture.

8.6 Road Markings, Warning Signs and Identification Labels

8.6.1 Warning signs for LPG compounds / cylinder stores shall be provided in accordance with the relevant provisions in Section 4.

8.6.2 If the underground bulk tank is located underneath driveway areas, the limits of the underground chamber shall be demarcated in yellow reflective paint, including letterings of convenient sizes indicating that no parking of vehicles is allowed.

8.6.3 The designated unloading bay for the LPG road tanker shall be demarcated with the perimeter painted in yellow reflective paint with letterings of convenient sizes indicating that it is for LPG road tanker unloading. However, when the unloading bay is entirely within the fenced-off area of the LPG compound, its function is obvious and the above road markings would not be required.

8.6.4 All aboveground valves that can be operated manually should be provided with the correct identification labels and, where applicable, diagrams of “open/closed” positions. Other critical devices / components that should also have identification labels include (but not limited to) the earthing connection for road tanker, the extended fill connection and all emergency shut-down release points.

8.6.5 The critical valves and fittings inside the tank manhole assembly that are accessible for operation or taking of readings should have correct identification labels affixed at convenient nearby positions.

SECTION 9 TESTING AND COMMISSIONING

9.1 General

9.1.1 LPG installations shall be tested and commissioned in accordance with the appropriate standards, codes of practice, drawings, specifications, manuals, etc. manufacturer reports/catalogues for bulk tanks, vaporisers and equipment, etc. shall also be referred to accordingly.

9.1.2 Cathodic protection, earthing, electrical continuity, insulating flange isolation and static bonding arrangements shall be tested in accordance with appropriate standards.

9.1.3 Relevant tests on bulk tanks, vaporisers and associated piping system shall be carried out by a Gas Systems Contractor and certified by a Class 1a Competent Person.

9.1.4 All purging, testing and commissioning work shall be carried out by Gas Systems Contractor. In particular, throughout the flaring operations, the Competent Person of the Gas Systems Contractor shall be in full attendance on location.

9.1.5 Appropriate personal protective clothing and safety equipment including handheld/portable flammable gas detectors shall be used by people involved with LPG work.

9.1.6 Fire service installations and equipment shall be made available during purging and commissioning work.

9.2 Documentation and Records

9.2.1 Records and certificates of all test carried out under this Section shall be retained for the service life of the equipment concerned.

9.2.2 Test records or certificates should contain, but not limited to, the following information, as appropriate:

a) GasSO approval letter for new tank, or Form EMSD/GSO/106 Testing and Examination Report of LPG Tank (Appendix G1) for revalidated tank;

b) Form EMSD/GSO/108, Testing and Examination Report of LPG Pipes (Appendix G3).;

c) Test Report for Pressure Relief Valves, if applicable;

d) Form EMSD/GSO/107 Test Report for Vaporisers (Appendix G2).

e) Test Report for LPG Control System;

f) Test Report for Emergency Shut-down System;

g) Test Report for Fire Service Installations including gas detection system such as Certificate of Fire Service Installations and Equipment (F.S. 251);

h) Test Report for Electrical Installations including, earthing, electrical continuity, static bonding arrangement, insulation flange isolation;

i) Cathodic Protection System Test Reports; and

j) Other test reports if required.

9.3 Bulk Tank Testing

9.3.1 The following tests shall be required for bulk tanks:

a) hydraulic test;
b) ultrasonic thickness test;
c) radiography test (for new tank only);
d) magnetic particle test;
e) Charpy impact test at minimum design temperature (for new tank only);
f) paint thickness test; and
g) holiday test.

These are normally done by the tank manufacturer, before tank delivery. All these test reports shall be submitted to the Gas Authority as part of the tank approval process (refer to Section 3.2).

9.3.2 Bulk tanks shall be hydraulically tested at 1.5 times of their design pressure for integrity, unless otherwise specified by their respective design code.

9.3.3 All connections of bulk tanks and associated fittings shall be leak tested to a minimum pressure of 689 kPa (100 psig) by air or inert gas.

9.3.4 After leak test, the system shall be purged into service as per Section 9.8.1.

9.4 Vaporiser Testing

9.4.1 The following tests shall be required for vaporisers:

a) Hydraulic test;
b) Functional test of temperature controls;
c) Functional test of water level control for water bath type vaporisers; and
d) Functional test of device preventing liquid pass through.

9.4.2 Vaporisers shall be hydraulically tested at 1.5 times of their design pressure for integrity, unless otherwise specified by their respective design code.

9.4.3 All connections of vaporisers and associated fittings shall be leak tested by air or inert gas to a minimum pressure of 689 kPa (100 psig) or at the pressure specified by their respective design code.

9.4.4 Results of the tests shall be recorded in Form 107 (Appendix G2).

9.5 Pipework Testing

9.5.1 All pipework shall be tested after construction and before being placed in operation to ensure that it is structurally sound and gas-tight. In carrying out the test, precautions shall be taken to protect:

a) the person carrying out the test;
b) any persons working in the vicinity; and
c) members of the public,

against any dangers which may arise if such pipe fails the test.

9.5.2 All pipework shall be pressure tested as follows:

a) All liquid lines shall be hydraulically tested for integrity at 1.1 times the HPRV setting after isolation of elements that could be damaged by the test pressure. Pressure test certificates shall state HPRV setting in addition to hydraulic test pressure.

   After the hydraulic test is completed, all isolated elements shall be properly installed and the whole system shall be tested pneumatically for leakage at a minimum pressure of 689 kPa (100 psig).

b) High pressure vapour lines shall be tested either pneumatically or hydraulically at a minimum pressure of 1 034 kPa (150 psig).

   Note: *The test pressure is based on 1.5 times the maximum working pressure. The maximum working pressure taken as the vapour pressure of LPG at 37.8^{o}C is generally within the range of 517 - 689 kPa (75 - 100 psig). The test pressure at 1 034 kPa (150 psig) minimum shall have adequate coverage.*

c) Medium and low pressure vapour lines shall be tested either pneumatically or hydraulically at a minimum pressure of 103 kPa (15 psig) and 69 kPa (10 psig) respectively.

9.5.3 Time shall be allowed for temperature stabilisation during pressure testing. The line pressure shall be adjusted to the test pressure after stabilisation.

Note: *The time allowing for temperature stabilisation depends on the ambient temperature, test medium, pipe size and length. Generally, this shall not be less than 15 minutes.*

9.5.4 For pneumatic testing, the test shall be undertaken in phases as follows:

a) Initially pressurise the system to 140 kPa (20 psig) and hold it for sufficient time to ensure that all fittings have been adequately fastened.

b) The pressure shall then be raised in stages until the required test pressure is reached.

c) After each pressure increase, sufficient time shall be allowed to ensure system integrity.

9.5.5 For hydraulic and pneumatic pressure test, the test period shall be of a minimum of 30 minutes and there shall be no sign of pressure decay during this period. Care should be taken of the pipework which may suddenly rupture due to the pressure test.

Note: *Pressure decay indicates leakage and leaks shall then be identified by sight and sound or soap solution.*

9.5.6 All open ends of a piping system shall be suitably **blanked before testing.**

9.5.7 Pipework pressure tests shall be recorded and the test report shall include the following:

a) name of contractor, and signature of the Competent Person who supervised the tests;
b) test date;
c) maximum working pressure;
d) test pressure, medium and duration;
e) test results; and
f) material, rating and specification of pipework and fittings.

9.5.8 The pressure of the pipework shall be reduced to zero as soon as is practicable after the pressure tests (see Gas Safety (Gas Supply) Regulation 20). Upon satisfactory completion of pressure tests, the pipework shall be purged into service in accordance with Section 9.8.2 prior to commissioning and operation of the LPG installation.

9.5.9 Test results shall be recorded in Form 108 (Appendix G3).

9.6 Testing of Cathodic Protection System

The cathodic protection system shall be tested according to the procedure as specified by the cathodic protection specialist.

9.7 Other Testing

Other special equipment that may be used in the LPG compound / cylinder store but not covered by other parts of this Section should be tested according to the manufacturer's instructions.

9.8 Purging into Service

9.8.1 The procedure of purging into service of bulk tanks is as follows (pressure and vent method):

a) After pressure testing of a bulk tank, inert gas (e.g., N_2) is added to the bulk tank through a top inlet point, and air inside the tank is vented from the bottom drain port.

b) The person supervising the purging should be aware of any dead ends or blind pockets, and use pressure and vent procedures to ensure that the gas mixture inside the tank is reasonably homogeneous.

c) End point is reached when the O_2 content is below 9% by volume.

Note: *If the medium of pressure test is inert gas, this procedure is not necessary as long as the inert gas is maintained above atmospheric pressure within the bulk tank.*

d) To prevent rapid vaporisation of LPG liquid, only vapour LPG shall be admitted into the bulk tank until the tank pressure is close to the supply pressure.

e) Before the flaring process, the Fire Services Communications Centre should be informed.

f) A flare stack located in a safe area shall be connected to a suitable vapour connection near the top of the tank for flaring off the LPG/inert gas. The flare stack shall be equipped with a permanent pilot and a flame arrestor. Care shall be taken to ensure complete removal of the inert gas (a stable flame at the flare stack) before terminating the flaring process.

g) Introduce vapour LPG into the tank through the bottom drain port to drive out the inert gas inside the tank. The flare stack, with the pilot permanently lit, should be connected at all times. Once the inert gas is driven out of the tank and LPG begins to pass through, the flare would be lit up by the pilot flame. Continue flaring until a steady flame is achieved.

h) Disconnect the flare and plug off the connection. Continue filling with LPG vapour until the tank pressure reaches the vapour pressure of the LPG.

i) The tank shall be replenished according to Section 10.2.

Note: *While flaring is in process, the road tanker shall not be in the LPG compound.*

9.8.2 The procedure for purging into service of pipework (including vaporisers and associated equipment) is as follows:

a) Before introducing LPG into the pipework or equipment, it shall be purged with inert gas (e.g., N_2) so that oxygen is reduced to a level of less than 9% by volume. Inert gas shall be introduced in a controlled manner by adjusting the pressure regulator.

b) The person supervising the purging should be aware of any dead ends or blind pipe sections, and use pressure and vent procedures to ensure that the gas mixture throughout the pipework or equipment is reasonably homogeneous.

c) Before putting liquid LPG into the liquid pipework or equipment, vapour LPG shall be introduced into the pipework or equipment up to the vapour pressure of LPG in order to avoid sudden chilling of the pipework.

d) For pipework sizes up to 32 mm nominal bore, LPG/inert gas mixture may be dispersed under proper supervision to a well-ventilated area without any source of ignition. For pipework sizes above 32 mm nominal bore, a flare stack with permanent pilot shall be used and shall be located at a safe distance away from the bulk tanks and other vulnerable structures.

e) Care shall be taken to ensure removal of the inert gas (a stable flame at the flaring stack) before terminating the flaring process.

9.9 Commissioning

9.9.1 All equipment, joints and valves, etc., shall be checked for leakage, integrity and proper function before commissioning.

9.9.2 Pressure regulators shall be set to their lowest outlet pressures initially and gradually adjusted to their required operating pressures. The regulators shall be checked for their pressure control function over the entire range of the design conditions including shut-off capability.

9.9.3 LPG trap shall be checked to ensure that it is topped with water (see Appendix C).

9.9.4 Active and monitor regulators shall be set during commissioning for the designed function in case of active regulator failure.

9.9.5 Vaporisers including their heat and level controls shall be checked for their satisfactory operation.

9.9.6 The operation of fire service installations and equipment where fitted, shall be checked for its satisfactory performance, and a Fire Services Certificate (F.S. 172) issued by FSD and a Certificate of Fire Service Installation and Equipment (F.S. 251) issued by a registered fire service installation contractor of the appropriate class should be obtained before putting the LPG installation into operation. For installations not involving the issue of Fire Services Certificate (F.S. 172) under the jurisdiction of the Building Authority, just solely the F.S. 251 will be acceptable.

SECTION 10 OPERATIONS

10.1 General

10.1.1 Operating instructions shall be in place to ensure safe, continuing and reliable operation of the installation in supplying gas to consumers.

10.1.2 Persons engaged in LPG operation shall:

a) be provided with extensive training in their specific areas of responsibilities;

b) be thoroughly familiar with the properties of LPG;

c) have knowledge of and access to the appropriate codes of practice at all times;

d) have specific guidance on the instructions to be followed under emergency conditions;

e) be familiar with different types of fire fighting and fire control equipment, including fire extinguishers;

f) ensure that the LPG storage does not exceed its approved quantities; and

g) ensure that all fire extinguishers are clearly identified for their types and expiry dates.

10.1.3 The NGI owner shall have a training manual in place covering the above and ensure that the persons engaged in LPG operation (such as the gas supply company or Gas Systems Contractors) have proper training records kept, and retained for not less than 2 years. (For sample training manual outline, refer to Appendix K).

10.1.4 If the NGI owner does not have the resources in house to operate the system safely, an agreement should be in place with the gas supply company, Competent Persons and / or Gas Systems Contractor to provide this service.

10.1.5 The NGI owner shall develop an emergency response plan to deal with emergency covering situations of LPG leakage, fire and explosion occurring at the LPG compound or cylinder store or at neighbouring properties. Details of these requirements are in Section 3.2 of Code of Practice for Hong Kong LPG Industry Module 7.

10.2 Replenishment of LPG Tanks

10.2.1 Off-loading of LPG shall be carried out by at least 2 competent road tanker operators (see Gas Safety (Gas Supply) Regulation 39), one of whom may be the road tanker driver. Details of these requirements are in Section 8.1 of Code of Practice for Hong Kong LPG Industry Module 3.

Note: *In the case of extended fill-connection, the driver shall stay close to the road tanker to monitor off-loading while his assistant shall monitor the filling in progress at the LPG tank.*

10.2.2 Persons engaged in off-loading of LPG shall be suitably trained in first aid, fire fighting and emergency response.

10.2.3 Persons engaged in off-loading of LPG shall wear suitable protective clothing to avoid frostbite, which can occur if LPG comes in contact with unprotected skin.

10.2.4 A reporting procedure shall be instituted to record every accidental LPG release, equipment failure or personal injury that may occur during the off-loading operation.

10.2.5 The road tanker shall be parked in a designated tanker bay facing the exit so that it can be towed or driven straight out in an emergency.

10.2.6 During the period of LPG unloading from the road tanker (and also during other times when maintenance / repair works are being carried out within the LPG compound), it shall be ensured that all the exit gates remain open or can be readily opened from the inside any time during emergency.

10.2.7 The following precautionary measures shall be observed throughout the LPG off-loading operation:

a) The hand brake of the road tanker shall be applied and the chock blocks securely fitted to the underside of the wheels.

b) The surrounding shall be checked to ensure that neither source of ignition nor flammable material is present.

c) Fill-connections shall be visually checked to ensure that they are in safe working conditions.

d) The driver should maintain a direct sight between the road tanker and the filling connection during the off-loading.

e) The storage capacity of the tank to be filled shall be carefully monitored throughout the filling operation by means of the content gauges to avoid over-filling. A tank percentage to litre conversion chart shall be made available at the site. Bulk tanks should not be filled beyond the maximum level (85% or otherwise specified) as per Section 5.2.5.1.

f) Earthing/bonding cable shall be engaged before connecting the fill-hose and be disengaged after disconnecting the fill-hose. Earthing/bonding cable and driveaway coupling shall be connected throughout the entire off-loading operation.

g) Fill-connections and fill-hoses shall be checked for leakage throughout the operation.

h) For installations of more than one tank, each tank shall be filled separately.

i) Fire extinguishers shall be located at easily accessible positions with warning notices prominently displayed (see Gas Safety (Gas Supply) Regulation 38(1)(b)).

10.3 Replacement of LPG Cylinders

10.3.1 This Section covers the operation of cylinder replacement for piped-cylinder stores.

10.3.2 Normally a cylinder store may only store the cylinders authorized by a Registered Gas Supply Company. On receiving the initial approval of use by the Gas Authority, the cylinder store should already has had an authorization letter from a Registered Gas Supply Company allowing its cylinders to be stored at the particular store. No cylinders from another Registered Gas Supply Company may be stored unless the existing authorization is revoked and a new authorization is obtained, and the Gas Authority is duly notified.

10.3.3 At outlying islands, common cylinder stores shared by various gas supply companies may be established. Approval shall be obtained from the Gas Authority for such shared storage. A proper operation and management procedure shall be in place to ensure that the facility is operated by all gas supply companies in a safe and well-coordinated manner.

10.3.4 The cylinder valve and the isolation valve at the manifold shall be closed before disconnecting each cylinder.

10.3.5 The condition of cylinder valves and connections shall be examined for any defects. Any cylinder with damaged or defective threads shall be conspicuously marked for returning to the oil terminal.

10.3.6 Cylinders shall be properly installed and securely in an upright position and should be secured by chains if necessary.

10.3.7 After a cylinder has been replaced, the cylinder valve shall be gently opened and checked for leakage with soap solution.

10.3.8 Before removing any cylinder from the store, the cylinder valve should be recapped.

10.4 Reinstatement of Gas Supply After Interruption

10.4.1 Proper gas reinstatement procedure needs to be followed after a gas interruption, to guard against the risk of appliances being left in the “on” position when gas

supply is resumed, leading to gas leakage. (Refer to Appendix J for suggested gas resumption procedure).

10.5 Draining of Heavy Ends

10.5.1 Heavy ends shall be drained from the vaporiser, and downstream of the first stage regulator, at a minimum frequency of twice per year. (Refer to Appendix J for suggested heavy ends draining procedures).

10.6 Miscellaneous

10.6.1 Gas supply companies shall report major gas emergencies to the Gas Authority and shall respond to any report of gas escape in accordance with Gas Safety (Registration of Gas Supply Companies) Regulations 15 and 16 respectively. Details are in Code of Practice for Hong Kong LPG Industry Module 7.

10.6.2 In the event of any system/equipment failures or emergencies, a record of failed equipment or components, actions taken and relevant information shall be kept by the NGI owner for subsequent investigation and examination.

10.6.3 Operational checks such as housekeeping, conditions of regulators and pressure gauges, LPG inventory level, and water level of certain vaporisers, etc., shall be carried out and logged on site as appropriate to ensure safety and proper function of the system. The NGI owner should adopt a frequency of checks suitable for the operational needs of the installation. (Refer to Appendix J for suggested check items).

SECTION 11 PERIODIC INSPECTION AND MAINTENANCE

11.1 General

11.1.1 The owner of an LPG installation shall have a duty to maintain and operate the installation in a safe condition and shall employ a Competent Person to inspect the installation at intervals as specified in Section 11.3.

11.1.2 Persons engaged in maintenance work shall have access to maintenance manuals and operating instructions and shall adhere to them accordingly.

11.1.3 No unauthorised person shall be permitted to gain access to LPG installations. A proper work permit system incorporating formal procedures shall be instituted for cold work, hot work and entry to bulk tanks.

11.1.4 Work permits shall be kept for 5 years as part of the maintenance records.

11.1.5 Before re-commissioning, care shall be taken to ensure that all tanks, vaporisers, equipment and associated pipework/fittings (including electrical bonding) are properly re-instated and leak tested satisfactorily.

11.2 Maintenance

11.2.1 Maintenance work shall be carried out by suitably trained and experienced persons. Maintenance of LPG tanks, vaporisers, pipework, pressure regulators and associated equipment in LPG compounds and cylinder stores as well as LPG mains shall be carried out by Gas Systems Contractor.

11.2.2 Routine maintenance schedule shall be planned in accordance with manufacturers' instructions to ensure safety and proper function of the system. The schedule may also depend on the individual site conditions and past maintenance records.

11.2.3 Site environment shall be maintained in good conditions so that it is free of overgrown vegetation and irrelevant materials. Overgrown weeds, long grass, deciduous shrubs / trees and any combustible materials shall be removed from an area within 6 m of the extended fill-connection and manhole assembly of the LPG tank. Chemical weed killers or any other method which may create a source of ignition shall not be used within these areas.

11.2.4 Fire extinguishers, gas detectors and water spray systems (if any) shall be checked, tested and maintained at regular intervals in accordance with the manufacturers' instructions or other schedules specified by the Fire Services Department.

11.2.5 Vaporisers including water level controls, heat input controls and solenoid valves, etc. shall be checked and maintained at regular intervals in accordance with manufacturers' instructions.

11.2.6 LPG tanks, pipework and associated fittings shall be inspected and properly maintained at regular intervals against corrosion.

11.2.7 Pigtails for piped-cylinder stores shall be replaced when they show visible signs of deterioration and in any case at intervals not exceeding 5 years (see Section 5.3.2).

11.2.8 All other equipment (e.g., pressure gauges and pressure regulators, etc.) shall be checked and maintained to ensure satisfactory conditions and proper functions in accordance with manufacturers' instructions at intervals not exceeding 1 year as practicable and replaced with new or reconditioned units as necessary.

11.2.9 Maintenance records shall be kept by the owner for the service life of the installation.

11.3 Tests, Examinations and Inspections

11.3.1 General

11.3.1.1 Tests and examinations for revalidation of tanks, vaporisers, pipework and associated fittings, etc. shall be carried out in accordance with the schedule in Appendix I. The schedule shall be planned well ahead to ensure timely completion of the work.

11.3.1.2 Examination, inspection and certification of LPG cylinders, tanks, vaporisers, pipework or associated fittings shall be carried out by a Competent Person. Test certificates and examination records shall be kept for the service life of respective equipment/system.

11.3.1.3 When it is necessary to purge LPG tanks, vaporisers, pipework or associated fittings out of service for examinations and inspections, the procedures in Section 9.8 shall be followed.

11.3.2 LPG Tanks

11.3.2.1 Aboveground tanks shall be subject to visual external examination at intervals not exceeding 5 years. At 10-year intervals, aboveground bulk tanks shall also be subject to magnetic particle, ultrasonic thickness and hydraulic tests (see Gas Safety (Gas Supply) Regulation 8(3)). If manhole is provided, internal visual examination shall also be required.

For tanks with fireproof coating, they shall be subject to visual internal and external examinations, magnetic particle, ultrasonic thickness and hydraulic tests at intervals not exceeding 5 years.

11.3.2.2 Underground/mounded bulk tanks shall be subject to test and examination not exceeding 10 years after being put into service. Thereafter, tanks shall be examined and tested at intervals not exceeding 5 years (see Gas Safety (Gas Supply) Regulation 8(4)). The following tests and examinations shall be performed:

a) Hydraulic test at 1.5 times the maximum design pressure, or otherwise as per tank design code.

b) External and internal (where possible) visual inspection.

c) Ultrasonic test for shell plate thickness.

d) Magnetic particle test for weld seams.

e) Test and examination of tank fittings.

f) Paint thickness and holiday test.

g) Cathodic protection test.

h) Electrical continuity, earthing continuity and insulation flange impedance test.

i) Pressure relief valve test (only if it is re-tested instead of being replaced).

j) Tank pneumatic tightness test report; and

k) Pipework hydraulic (only if pipework has been modified) and pipework pneumatic tightness test reports.

These test and examination results shall be reviewed by a Class 1a Competent Person, who shall make a judgement on the fitness of the tank for continued service. The test results and the Competent Person's judgement shall be reported in Form 106 (refer to Appendix G1). The document shall be kept for the service life of the tank.

11.3.2.3 For visual examination of bulk tanks, special attention shall be given to signs of corrosion, deterioration, condition of tank supports and welded joints.

Any defects shall be rectified prior to recommissioning of the bulk tanks (see Gas Safety (Gas Supply) Regulation 8(6)).

11.3.2.4 Pressure relief valves shall be replaced at intervals not exceeding 5 years with new or reconditioned/retested units of appropriate set pressure and capacity. For testing of pressure relief valves, it shall be done in accordance with an established code, such as AS 3788 Appendix X. If the bulk tank is under pressure, the relief valve(s) shall not be removed unless a multiport or check device is provided. In this case, a serviceable relief valve shall be made available for immediate replacement.

11.3.2.5 Cathodic protection system shall be checked for its proper function at intervals not exceeding 6 months, and its records maintained for the service life of the tank (see Gas Safety (Gas Supply) Regulation 12 (2)).

11.3.3 Vaporisers

11.3.3.1 Vaporisers shall be subject to hydraulic and functional tests at intervals not exceeding 5 years in accordance with respective design codes (see Gas Safety (Gas Supply) Regulation 14). Test and examination results shall be reported in Form 107 (refer to Appendix G2). Test records shall be kept for the service life of the vaporiser.

11.3.3.2 Pressure relief valves shall be replaced at intervals not exceeding 5 years with new or reconditioned/retested units of appropriate set pressure and capacity.

11.3.4 Pipework

11.3.4.1 All exposed pipework shall be subject to annual visual examination and leak test under operating pressure using soap solution.

11.3.4.2 Pressure tests shall be carried out in accordance with Section 9.5 if a section of pipework has been modified. If only re-instatement of disconnected pipework, or replaced/repaired fitting and equipment such as pressure gauges and regulators are involved, a leak test shall be carried out. This leak test shall be carried out by the Competent Person of the Gas Systems Contractor, and recorded in his/her job record accordingly.

11.3.4.3 HPRVs shall be replaced at intervals not exceeding 10 years with new units of appropriate set pressure.

11.3.5 LPG Compounds and Cylinder Stores

11.3.5.1 An LPG compound or cylinder store shall be inspected annually by a Class 2 Competent Person to ascertain whether the installation is maintained and operated in a safe manner in accordance with relevant sections in this module. The owner of the LPG compound or cylinder store shall submit such inspection reports (refer to Appendix H) to the Gas Authority within four weeks after the inspection, according to the Regulation 6C of the Gas Safety (Gas Supply) Regulations. (Refer to Section 3.4.4).

11.3.5.2 The NGI owner of an LPG compound or cylinder store shall carry out the necessary remedial work as identified in the inspection reports. (Refer to Section 3.4.4).

11.4 Alterations to LPG Installations

11.4.1 In accordance with Regulation 4 of the Gas Safety (Gas Supply) Regulations, modifications of LPG facilities shall not be made without approval from the Gas Authority.

11.4.2 Major alterations to an LPG facility require construction approval and approval of use from the Gas Authority using Form 104 and Form 105. In general, the following constitute major alterations:

a) Change of the mode of storage

b) Increase in storage capacity

c) Increase in capacity of vaporisers

d) Change in the LPG facility that will affect gas safety and supply security

The list is not exhaustive, and the Gas Authority should be consulted if any changes are planned. Even if no construction approval or approval of use is required, notification to the Gas Authority should be made before any work can be carried out.

SECTION 12 DECOMMISSIONING

12.1 General

12.1.1 When an LPG installation, or part of an installation, ceases to operate, it shall be decommissioned properly so that it does not pose a risk to the public.

12.1.2 Until the LPG installation is certified to be gas free, it shall be treated as a gas installation and a Gas Systems Contractor shall be employed for the decommissioning of the installation. In particular, throughout the purging and/or flaring operations, the Competent Person of the Gas Systems Contractor shall be in full attendance on location.

12.1.3 During the whole decommissioning process, the NGI owner shall make necessary arrangements to ensure compliance with the Factories and Industrial Undertakings Ordinance (Cap. 59) and the Occupational Safety and Health Ordinance (Cap. 509) and their subsidiary legislation with respect to the occupational health and safety of the employees, including in particular the handling of chemicals and entry into confined space as applicable.

12.2 Decommissioning Process

12.2.1 The system, including all tanks, vaporisers, pipework and associated equipment, or any part thereof, shall be purged out of service following proper procedures (refer to Section 12.3 and 12.4).

12.2.2 After gas freeing, the decommissioned system should preferably be dismantled and taken away from the site. If this is not possible and it has to be left in situ (e.g., buried pipework), records shall be left with the premises owner to indicate clearly where and what these are. The NGI owner shall coordinate with the premises owner on the arrangement of the left-in-situ pipework.

12.2.3 If the dismantled system or equipment is to be reused, they should be properly stored and maintained. All openings shall be properly capped or blanked off to prevent entry of foreign materials. If re-using the equipment, all the documents for the equipment shall be properly kept in place.

12.2.4 If a tank is to be filled with inert gas for corrosion prevention during storage, it shall have a warning sign indicating that it is filled with inert gas, so that it will not become an asphyxiation hazard to anyone who subsequently opens it up.

12.2.5 If a tank is to be sold as scrap metal, at least two holes of minimum 150 mm x 150 mm, or other shapes of equivalent sizes, shall be cut in the tank body at prominent positions to render it unable to be used as a pressure vessel. Aspects related to environmental protection, waste disposal, occupational safety and health, structural safety, etc., shall be referenced to other relevant ordinances and regulations.

12.3 Purging Tanks Out of Service

12.3.1 The procedure for purging LPG tanks out of service using inert gas is as follows:

a) The bulk tank to be purged shall be properly isolated and blanked off from other tanks and/or pipework using spades, blind flanges or locked valves.

b) Liquid LPG in a bulk tank shall be depleted as far as practicable through normal consumption or decanted to a road tanker prior to purging.

c) Decanting can be via a pump, or by a compressor.

d) A flare stack with a permanent pilot and flame arrestor, located in a safe area, shall be connected to a suitable vapour connection of the tank for flaring of the residual LPG vapour.

e) The Fire Services Communication Centre shall be notified prior to any flaring, and the flaring process shall be attended to at all times during purging.

f) When the vapour pressure inside the tank drops off, inert gas (e.g., N_2) can be introduced into the top of the bulk tank to drive out the remaining LPG, which shall now come out from the bottom drain connection. Continue flaring until the flame dies out (the permanent pilot shall remain lit all the time).

g) Flame-out at the flare stack does not indicate the end point of purging. A combustible gas detector shall be used to check to confirm the purging end point. The LEL of gas emerging from the tank shall be less than 5%.

h) The person supervising the purging should be aware of any dead ends or blind pockets, and use pressure and vent procedures to ensure that the gas mixture throughout the whole tank is reasonably homogeneous. Gas samples should be taken to confirm the purging end point.

i) Once the bulk tank is at atmospheric pressure, the manhole cover may then be removed and air be introduced into the tank.

j) No one shall enter into the tank until the internal atmosphere has been verified to be safe (LPG level less than 5% of the lower explosive limit and oxygen level not less than 18%). Detector probes shall be used to ensure that LPG is not present at the bottom of the tank and oxygen level is adequate inside every part of the tank.

   Entry into any confined space shall follow the procedure under the Factories and Industrial Undertakings Ordinance (Cap. 59) and the Occupational Safety and Health Ordinance (Cap. 509) and their subsidiary legislation.

k) The gas free status of the tank shall be certified by a Class 1a Competent Person. (Refer to Appendix L for sample gas free certificate).

12.3.2 Water can be used as a medium for purging instead of inert gas. The procedure shall be the same as per clause 12.3.1 except that water is introduced into the bottom of the bulk tank. However, the following extra precautions should be taken with water purging:

a) The tank shall be adequately vented to avoid creating a vacuum when the water is released.

b) The person supervising the purging should be particularly aware of dead ends or blind holes where gas pockets may be trapped. Proper measures to eliminate flammable gas trapped in these gas pockets shall be taken to ensure that no flammable gas remains in the system.

c) To minimise corrosion, the wet surface of the tank should be exposed to air for as short a time as possible.

12.4 Purging LPG Pipeline & Equipment Out of Service

12.4.1 The procedure for purging LPG pipeline and equipment out of service using inert gas is as follows:

a) The section of pipeline or equipment to be purged shall be properly isolated and blanked off from the rest of the system using spades, blind flanges, locked valves or physical separation.

b) LPG in the isolated pipeline section or equipment shall be depleted by flaring. A flare stack with a permanent pilot, located in a safe area, shall be connected to a suitable tee point of the pipeline, preferable at the end, for flaring of the residual LPG.

c) The Fire Services Communication Centre shall be notified of any flaring, and the flaring process shall be attended to at all times during purging.

d) When the vapour pressure inside the pipeline or equipment dies off, inert gas (e.g., N_2) can be introduced into a tee point at the other end of the pipeline or equipment to drive out the remaining LPG. Continue flaring until the flame dies out (the permanent pilot shall remain lit all the time).

e) Use pressure and vent method to drive out any LPG remaining in blind pockets and dead legs.

f) Flame-out at the flare stack does not indicate the end point of purging. A combustible gas detector shall be used to check to confirm the purging end point. The LEL of gas emerging from all available vent points shall be less than 5%. Enough time shall be allowed for the atmosphere inside the pipeline section or equipment to settle so that it reaches a homogeneous state, and the samples taken are representative.

g) Once the pipeline section or equipment is at atmospheric pressure, it may then be opened up for performance of work.

12.4.2 Water may be used as a medium for purging instead of inert gas. This is particularly effective for pipelines and equipment that are to be abandoned. The procedure shall be the same as 12.4.1.

12.4.3 The person supervising the purging should be particularly aware of dead ends or blind holes where gas pockets may be trapped. Proper measures to eliminate flammable gas trapped in these gas pockets shall be taken to ensure that no flammable gas remains in the system.

12.4.4 The gas freeing of pipeline and equipment shall be undertaken and recorded by a Gas Systems Contractor. If hot work is subsequently to be carried out on the pipeline or equipment, or the pipeline or equipment is to be decommissioned, it shall be an additional requirement for a Class 1a Competent Person to issue the gas free certificate.

Note: *The Competent Person supervising the hot work shall determine whether additional requirements are necessary, e.g., continuous monitoring and ventilation during work.*

12.5 Notification Responsibilities of NGI Owner

12.5.1 The NGI owner shall inform the Gas Authority in writing of cessation of operation of the NGI.

12.5.2 In the notification, the NGI owner shall include all gas free certificates to demonstrate that the LPG installation is properly decommissioned and gas freed.

12.5.3 If the facility has been dismantled, record photos of the dismantled facility shall be included in the notification to the Gas Authority.

12.5.4 Notification is also required when decommissioning or replacing vaporisers.

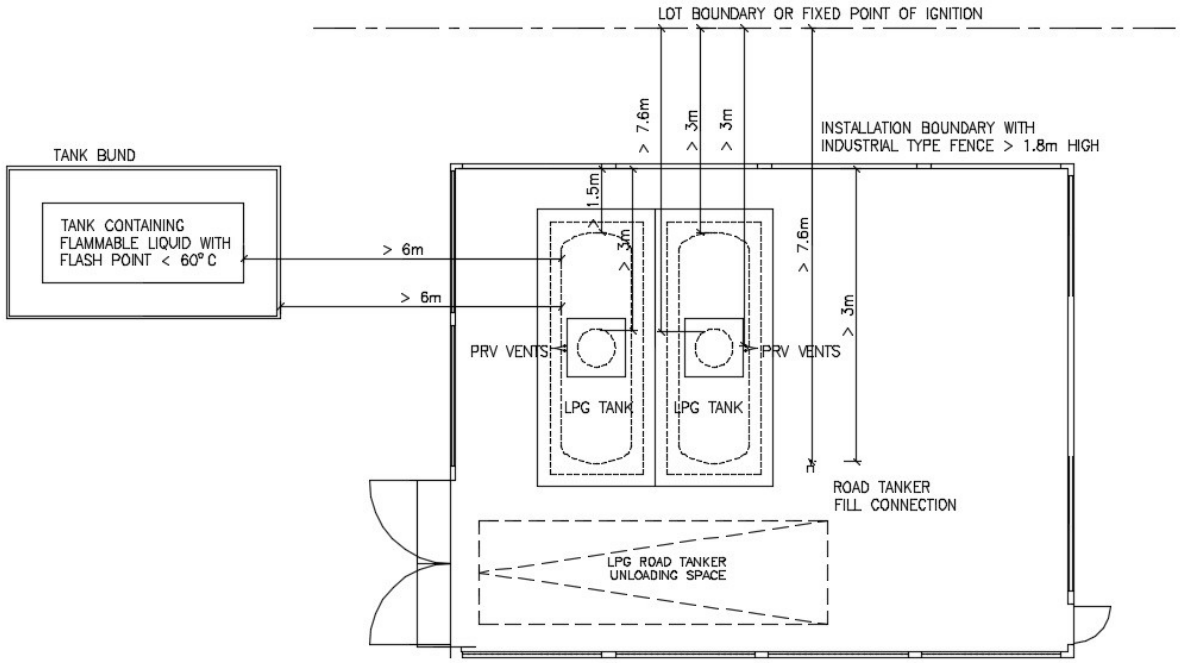
APPENDIX A RELEVANT SECTIONS IN RELATION TO THE GAS SAFETY REGULATIONS

Gas Safety (Gas Supply) Regulations	Relevant Sections in Module 1	Sections Quoted in Module 1
Reg. 2: Interpretation	1	-
Part II: Construction and use of notifiable gas installations (Reg. 3 – 6)	2.2, 3.1, 11.4	2.2.1, 3.1.1, 11.4.1
Part IIA: Safety and inspection of notifiable gas installations (Reg. 6A – 6C)	3.4, 11.1, 11.3.5, 12.5	3.4.1, 3.4.4, 11.3.5.1
Reg. 7: Only approved containers may be used to contain LPG	3.2	3.2
Reg. 8: Examinations and inspections to be carried out on cylinders and tanks	9.3, 11.3.2	11.3.2.1
Reg. 9: Pressure relief valves fitted to cylinders	-	-
Reg. 10: Filling capacity of tanks and cylinders	5.2.5, 10.2.6	5.2.5.1, 10.2.6 (e)
Reg. 11: Requirements for LPG storage installations	3.1.7, 4.1, 4.2, 4.3, 4.4, 5.1, 5.3, 5.4, 5.5, 5.8, 6, 7	3.1.7, 4.1.1.2, 4.1.1.3
Reg. 12: Requirements for tanks	4.1.3, 5.2, 11.3.2	5.2.3.2, 5.2.3.3, 11.3.2.5
Reg. 13: Provision of shut-off valves for vaporisers	5.4.1.8	5.4.1.8
Reg. 14: Testing and examination of vaporisers	9.4, 11.3.3	11.3.2.1, 11.3.2.2, 11.3.2.3
Reg. 15: Application	1	-
Reg. 16: Only competent persons to carry out work on or in relation to gas pipes	8, 9, 11, 12	-
Reg. 17: General safety requirements for gas pipes	5.6	5.6
Reg. 18: Enclosed gas pipes	8.5.9	-
Reg. 19: Protection of premises	-	-
Reg. 20: Pressure tests on gas pipes, etc.	9.5, 11.3.4	9.5.8
Reg. 21: General safety requirements for pressure-regulating installations	5.5	5.5.1.1
Reg. 22: Location of Pressure-regulating installations	5.5.3.1	-
Reg. 23: Purging, etc. of gas pipes	9.8.2, 12.4	-
Reg 23A: Works in the vicinity of gas pipes	-	-
Reg. 38: Certain equipment to be carried on gas vehicle	10.2.7 (i)	10.2.7 (i)
Reg. 39: Only competent persons to be employed on gas vehicle	10.2.1	10.2.1
Reg. 40: Safety device to be used when LPG is discharged from road tanker	4.1.5.7	4.1.5.7

Gas Safety (Registration of Gas Supply Companies) Regulations	Relevant Sections in Module 1	Sections Quoted in Module 1
Reg. 11: Certain persons only may store or transport gas	3.1.7	3.1.7
Reg. 15: Registered gas supply company to report major gas emergencies	10.6.1	10.6.1
Reg. 16: Reported escape of gas	10.6.1	10.6.1
Gas Safety (Gas Quality) Regulations	**Relevant Sections in Module 1**	**Sections Quoted in Module 1**
Gas Safety (Gas Quality) Regulations	2.2.4	2.2.4 (c)

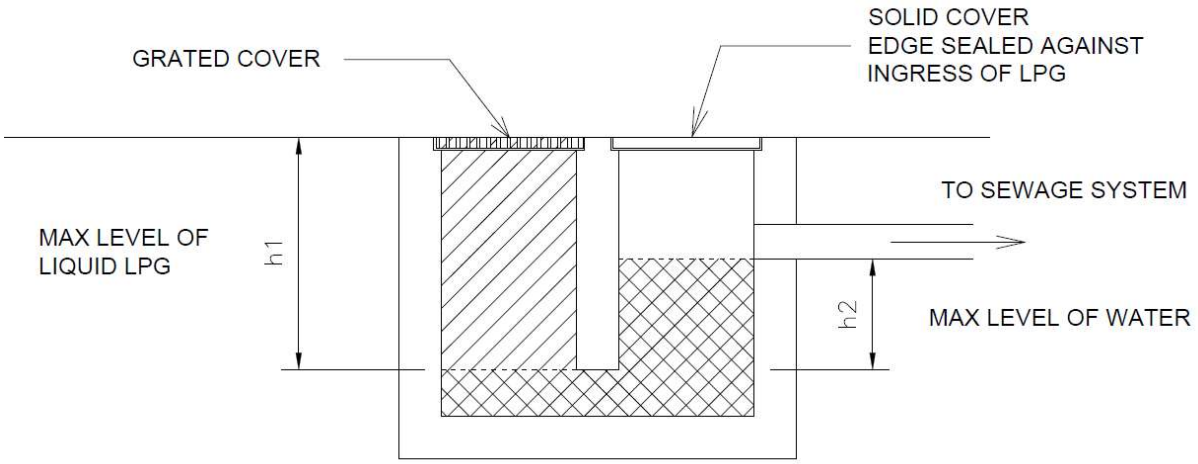
APPENDIX B MINIMUM SAFETY DISTANCES FOR UNDERGROUND/MOUNDED LPG BULK TANKS

	Underground Tank	Filling Connection or Tank Valve Assembly	PRV Vent Discharge
Lot boundary or fixed point of ignition	3m	7.6m	3m
Installation boundary (with industrial-type fence 1.8m high min.)	1.5m	3m	N/A
Vessel or bund wall of vessel containing any other flammable liquid with flash point below 60^{O}C	6m	N/A	N/A



APPENDIX C TYPICAL DESIGN FOR LPG TRAP

Sample Calculation of LPG Trap



h_1 is the required depth of the weir to prevent passage of liquid LPG through the trap to the sewage system. It is calculated based on that if h_2 is filled with water up to the bottom of the outfall pipe and h_1 is filled to grade with liquid LPG, the water in h_2 can balance the LPG in h_1 and thus in a no flow position.

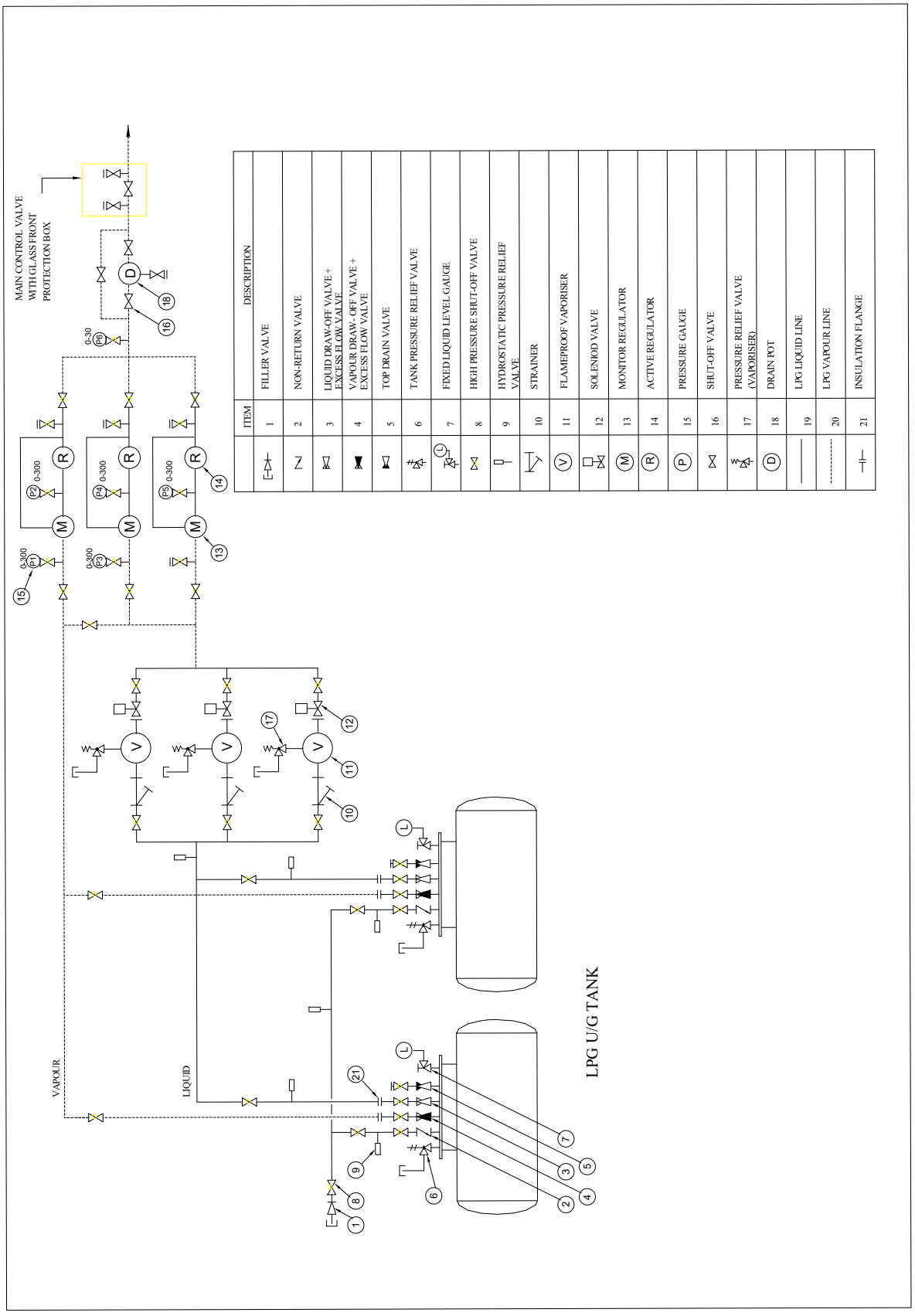
h_2 x (S.G. of water) = h_1 x (S.G. of LPG)
h_1 = h_2 x (S.G. of water) / (S.G. of LPG)

Notes on Calculation:

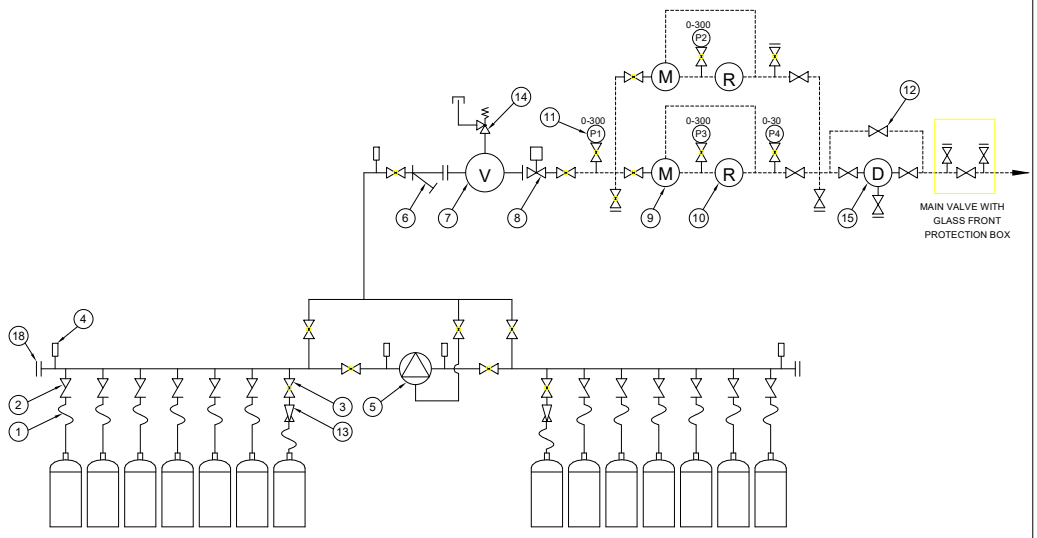
(1) The foregoing does not account for additional head of LPG above grade. Assuming a liquid spill, the height of the assumed layer above grade shall be added to the above calculation.

(2) S.G. = Specific Gravity

APPENDIX D TYPICAL SCHEMATIC DIAGRAM FOR LPG COMPOUND



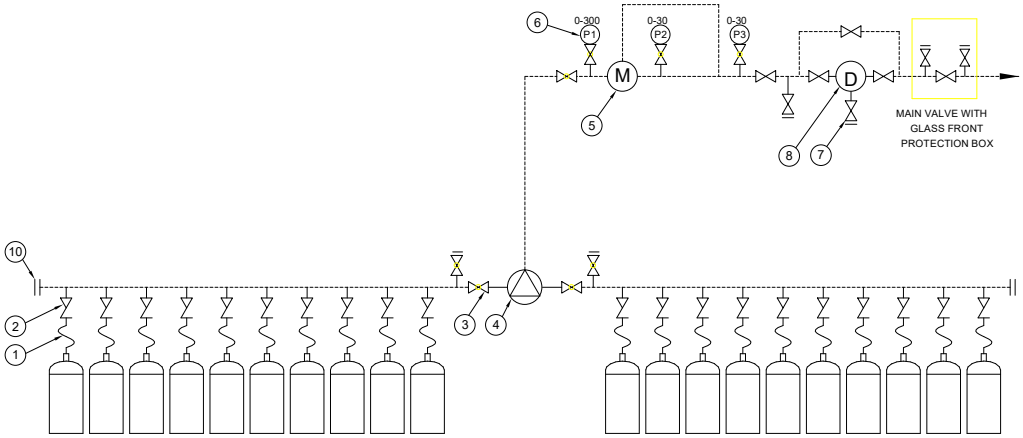
APPENDIX E TYPICAL SCHEMATIC DIAGRAM FOR PIPED-CYLINDER STORE



SCHEMATIC PIPING DIAGRAM

	ITEM	DESCRIPTION
	1	HIGH PRESSURE PIGTAIL
	2	HIGH PRESSURE SHUT-OFF VALVE WITH CHECK FUNCTION
	3	HIGH PRESSURE SHUT-OFF VALVE
	4	HYDROSTATIC PRESSURE RELIEF VALVE
	5	AUTOMATIC CHANGE OVER DEVICE WITH PRESSURE REGULATING FUNCTION
	6	STRAINER
V	7	FLAMEPROOF VAPORISER
	8	SOLENOID VALVE
M	9	MONITOR REGULATOR
R	10	ACTIVE REGULATOR
P	11	PRESSURE GAUGE
	12	SHUT-OFF VALVE
	13	EXCESS FLOW VALVE
	14	PRESSURE RELIEF VALVE
D	15	DRAIN POT
———	16	LPG LIQUID LINE
- - - - - -	17	LPG VAPOUR LINE
	18	FLANGE

Figure E1
Liquid Withdrawal



SCHEMATIC PIPING DIAGRAM

	ITEM	DESCRIPTION
	1	HIGH PRESSURE PIGTAIL
	2	HIGH PRESSURE SHUT-OFF VALVE WITH CHECK FUNCTION
	3	HIGH PRESSURE SHUT-OFF VALVE
	4	AUTOMATIC CHANGE-OVER DEVICE WITH PRESSURE REGULATING FUNCTION
M	5	MONITOR REGULATOR
P	6	PRESSURE GAUGE
	7	SHUT-OFF VALVE
D	8	DRAIN POT
	9	LPG VAPOUR LINE
	10	FLANGE

Figure E2
Vapour Withdrawal

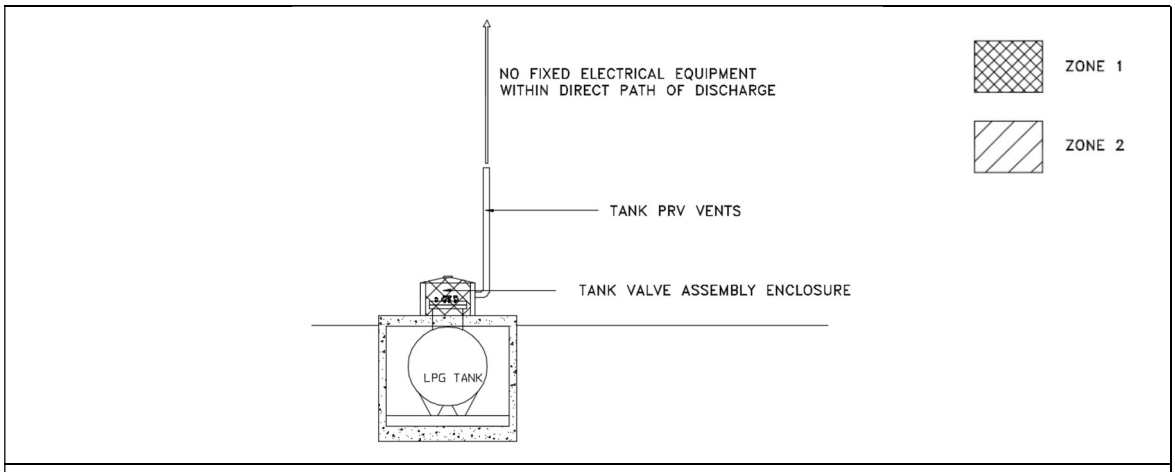
APPENDIX F AREA CLASSIFICATION FOR LPG COMPOUND AND CYLINDER STORE

Location	Extent of Classified Area	Area Classification
Bulk Tank	(a) Within 1.5m all directions from the fixed level gauge discharge (b) Entire valve assembly enclosure* (c) 4.6m all directions from the tank valve assembly (if not enclosed)* * **Note***: When carrying out cathodic protection checks with the valve assembly enclosure lid open, or where the valve assembly is not enclosed, the valve assembly enclosure (or the area around the valve assembly in case it is not enclosed) may be considered as un-zoned provided operating procedures require the lid to be opened and checked for presence of flammable atmosphere before the test is carried out.*	Zone 1 Zone 1 Zone 2
Pressure Relief Valve Discharge	Within the direct path of discharge.	No fixed electrical equipment
Fill-connection	(a) Within 1.5m in all directions. (b) Beyond 1.5m but within 4.5m in all directions, and within the cylindrical volume between the horizontal equator of the sphere and ground level.	Zone 1 Zone 2
Vaporiser (i) Outdoors - Including being under roof but with at least 2 sides open (ii) Indoors	(a) Within 1.5m in all directions of the drain point. (b) Beyond 1.5m of the drain point but within 4.5m in all directions from the vaporiser. (a) Within 1.5m in all directions of the drain point. (b) Beyond 1.5m of the drain point but within the entire room and any adjacent room not separated by a vapour-tight partition.	Zone 1 Zone 2 Zone 1 Zone 2

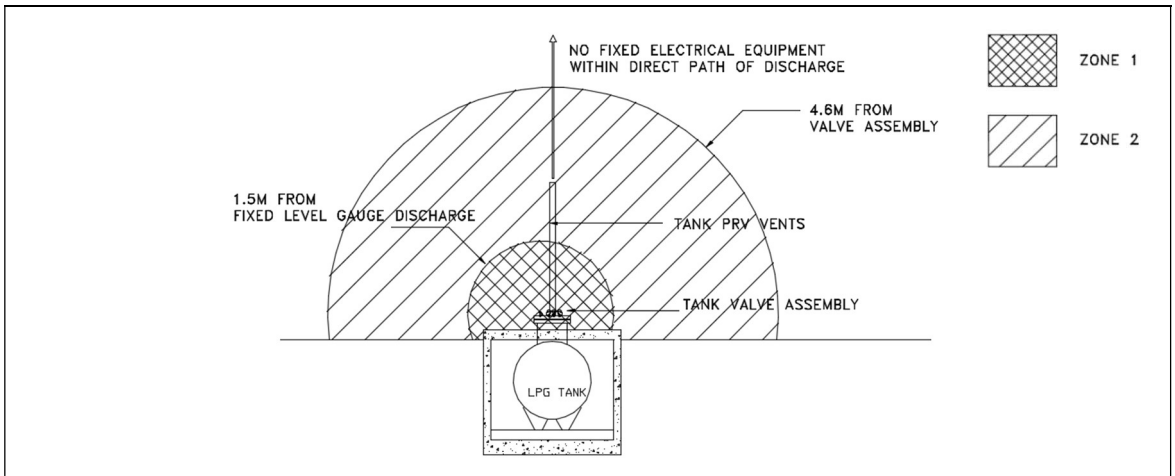
Cylinder Store		
(i) Open Air Storage	(a) The whole storage space up to a height of 1.5m above the top of the stack, or beneath any roof over the storage space.	Zone 2
	(b) As continuation to the outside of the space prescribed in (a), decreasing uniformly to the ground level within the separation distance set out in Table 4-1.	Zone 2
(ii) Storage Inside Building	(a) Inside building.	Zone 2
	(b) Outside any doorway, low level opening of the store, up to 1.5m above ground level and decreasing uniformly to the ground level within the separation distance set out in Table 4-1.	Zone 2

Note 1: *Any pit, trench, duct entry or depression falling within or below a Zone 1 or Zone 2 location shall be treated as being Zone 1 throughout, unless a suitable interceptor is installed.*

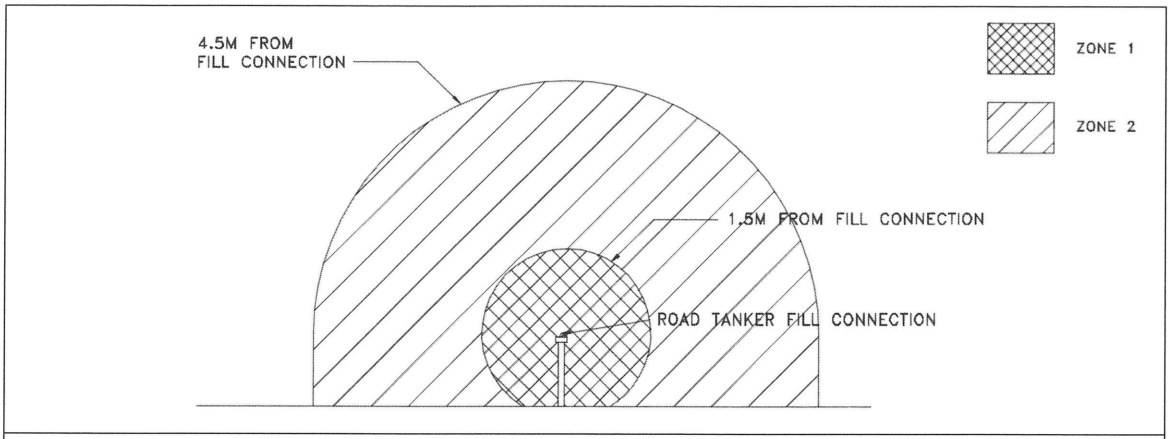
Note 2: *The term 'outdoors' includes vaporisers which are covered by a canopy / roof.*



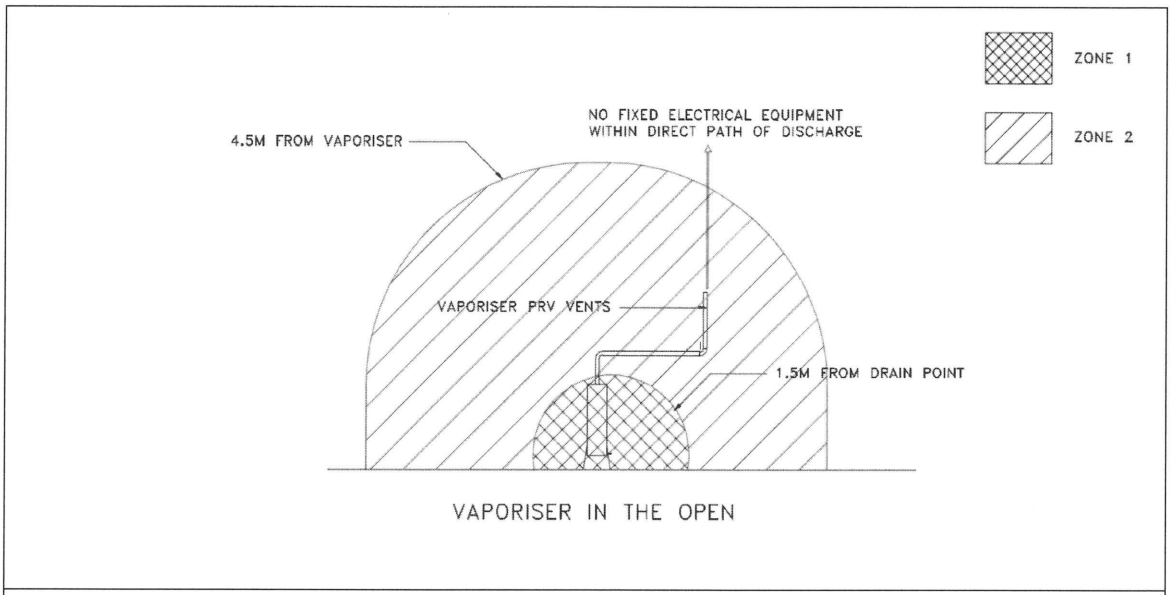
Tank with valve enclosure



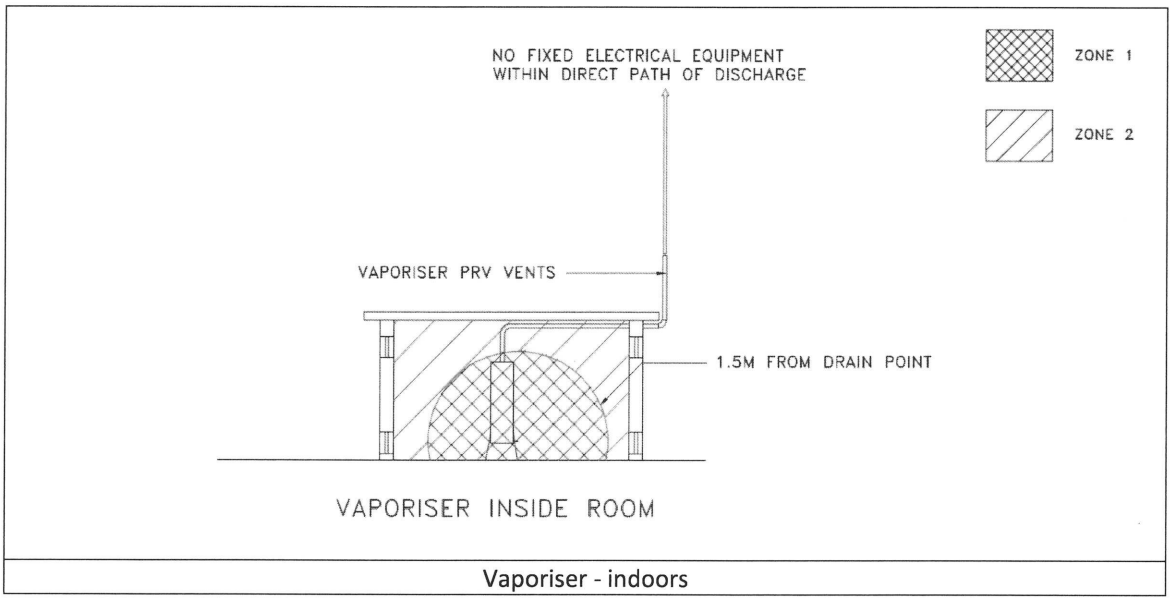
Tank without valve enclosure



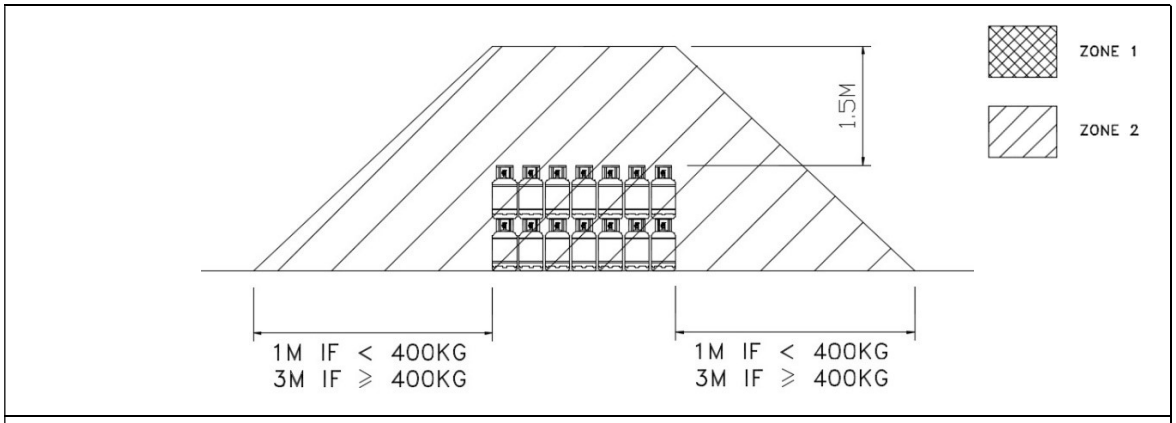
Fill connection



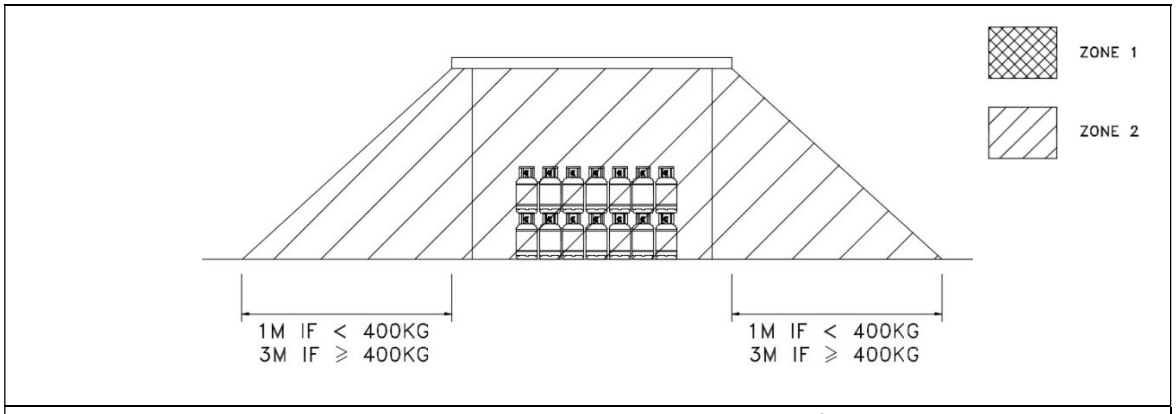
Vaporiser - outdoors



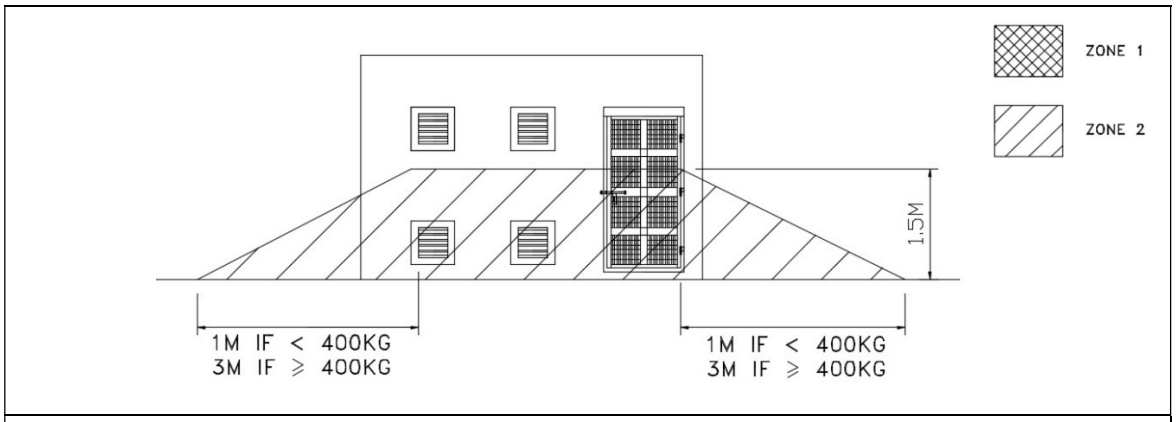
Vaporiser - indoors



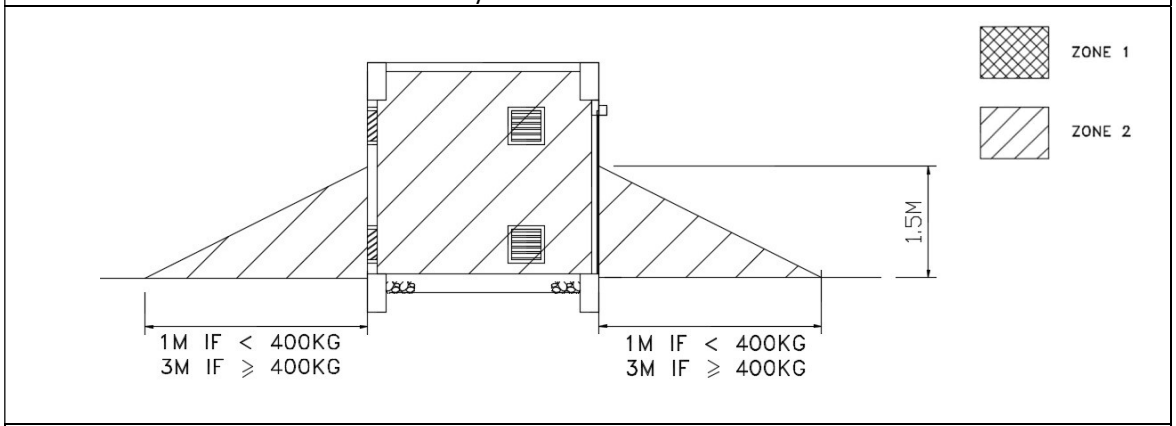
Cylinder storage in the open



Cylinder storage in the open but under roof



Cylinder store - exterior



Cylinder store - interior

APPENDIX G1

File Ref. : EMSD/GSD-B/

Testing and Examination of LPG Tank (Form 106)

under Regulation 8 of Gas Safety (Gas Supply) Regulations, Cap. 51

To : The Gas Authority

Address of Notifiable Gas Installation: _____

_____

Mode of Storage :_____

Serial No. :_____

Water Capacity :_____

Tank Design Code : _____

Date of Installation & Last Revalidation: _____

Test / Examination	Test Date(s)	Attached Document Reference No.	Tested by	Remarks
Hydraulic test				
Full visual inspection				
Ultrasonic thickness test				
Magnetic particle test				
Coating thickness & holiday tests				
Testing & examination of tank fittings				
Cathodic protection test				
Electrical continuity test				
Others (if applicable)				

Certified by Class 1a Competent Person:

I certify that the above tank has satisfactorily been tested and examined under my supervision in accordance with the Gas Standards Office's requirements in order to comply with Regulation 8 of the Gas Safety (Gas Supply) Regulations and it is suitable for continued LPG service.

Name: _____ Signature: _____

Date: _____

Form 106 revision: 05/2023

APPENDIX G2

File Ref. : EMSD/GSD-B/

Testing and Examination of LPG Vaporiser (Form 107)

under Part IV of Gas Safety (Gas Supply) Regulations, Cap. 51

To : The Gas Authority

Address of Notifiable Gas Installation: _____

_____

Part 1: Details of Vaporiser:

Make & Model:_____	Serial Number:_____
Date of Manufacture:_____	Vaporising Capacity (kg/hr):_____
Design Code:_____	Pressure Relief Valve:_____

Part 2: Hydraulic Test Details: (Date of Testing:_____)

Design Pressure (kPa):_____	Duration of Test (hr):_____
Test Pressure (kPa):_____	Test Result:_____

Part 3: Functional Test Details: (Date of Testing:_____)

Test description	**Result (Pass / Fail / Not Applicable)**	**Remark**
Temperature controls		
Water level controls (Water bath type)		
Device preventing liquid pass through		

Test carried out by Gas Systems Contractor & RGI:

_____

Certified by Class 1a Competent Person:

I certify that the LPG vaporiser(s) installed at the above premises has satisfactorily been tested and examined under my supervision in accordance with the Gas Standards Office's requirements in order to comply with Part IV of the Gas Safety (Gas Supply) Regulations.

Name: _____ Signature: _____

Date: _____

Form 107 revision: 05/2023

APPENDIX G3

File Ref. : EMSD/GSD-B/

Testing and Examination of LPG Pipes (Form 108)

under Part V of Gas Safety (Gas Supply) Regulations, Cap. 51

To : The Gas Authority

Address of Notifiable Gas Installation:_____

_____

Details of pipework materials and tests are as follows: (Date of Testing:_____)

Section of Pipework	All Liquid Lines	All High Pressure Vapour Lines	All Medium Pressure Vapour Lines	All Low Pressure Vapour Lines
Pipeline specification				
Fitting specification				
Valve material and rating				
Testing medium				
Working pressure (kPa)				
Test pressure (kPa)				
Duration of test (hr)				
Pressure setting of Hydrostatic Pressure Relief Valve (kPa)		N/A	N/A	N/A

Remarks : Pressure drop observed? Yes/No.

If 'Yes', please specify causes and remedial actions:_____

Test and examination was carried out by Gas Systems Contractor & RGI:

_____

Certified by Class 1a Competent Person:

I certify that all liquefied petroleum gas pipework installed at the above premises is constructed of suitable materials and has been tested/examined in accordance with the Gas Standards Office's requirements. All pipework has been adequately protected against corrosion in accordance with the specifications.

Name: _____ Signature: _____

Date: _____

Form 108 revision: 05/2023

FORM 109
REPORT OF ANNUAL INSPECTION OF LPG STORAGE INSTALLATION PURSUANT TO REGULATION 6C OF GAS SAFETY (GAS SUPPLY) REGULATIONS (Chapter 51B)

To：The Gas Authority

Section I Particulars of LPG Storage Installation

Location	
Owner	
Gas Supply Company	
Maintenance Contractor	
Type of Installation	LPG Compound / Piped-cylinder Store / Standby Cylinder Store *
Storage Quantity	k lit / cu. meter / kg *
Mode of Storage	Aboveground tank / Mounded tank / Underground tank / Cylinder (Liquid withdrawal) / Cylinder (Vapour withdrawal) / Cylinder *

** delete as appropriate*

Section IIa Inspection Checklist

A	**Site Condition**	***Please specify***			***Please specify***
1	Structures/fitments within safety distance	✓ / X / NA	4	Date of pipework test	D
2	Condition of sterile area	✓ / X / NA	5	Date of HPRV replacement	D
3	Condition of fence/boundary walls/gates	✓ / X / NA			
4	Housekeeping	✓ / X / NA	**E**	**Bulk Tanks & Tanker Bay***	
5	Condition of catchment pits/drains/gully covers	✓ / X / NA	1	Condition of valve chambers	✓ / X / NA
6	Type and number of certified unexpired fire extinguishers	✓ / X / NA	2	External condition of vessel chambers	✓ / X / NA
7	Condition of warning signs/emergency notices	✓ / X / NA	3	Internal condition of vessel chamber (ingress of water)	✓ / X / NA
			4	Provision of rain caps at PRV vent pipes, valve chamber covers, etc.	✓ / X / NA
B	**Record of Maintenance and Alterations**		5	Condition of PRVs and vent pipes	✓ / X / NA
1	Maintenance records	D	6	External condition of aboveground tanks	✓ / X / NA
2	Alteration records	D	7	Condition of earthing/bonding connection	✓ / X / NA
			8	Condition of breakaway coupling/loading arm	✓ / X / NA
C	**Vaporiser Room***		9	Date of tank revalidation	D
1	Housekeeping of vaporiser room	✓ / X / NA	10	Record of cathodic protection test	D
2	Condition of ventilation and explosion relief	✓ / X / NA	11	Record of routine test of fire fighting system	✓ / X / NA
3	Condition of vaporisers	✓ / X / NA			
4	Condition of PRVs and vent pipes	✓ / X / NA	**F**	**Cylinder Store***	
5	Date of vaporiser revalidation	D	1	Housekeeping of cylinder store	✓ / X / NA
6	Record of routine test of fire fighting system	✓ / X / NA	2	Condition of ventilation and explosion relief	✓ / X / NA
			3	Date of replacement of flexible gas tubings	D
D	**Pipework/Equipment***		4	Record of routine test of fire fighting system	✓ / X / NA
1	Condition of pipework/pressure regulators/valves/ gauges/fittings	✓ / X / NA			
2	Identification markings of pipework/valves/ fittings	✓ / X / NA	**G**	**Summary of Irregularities Observed/Other Information**	
3	Identification and functional markings of main control valve	✓ / X / NA		(To be provided in Section IIb)	D

** if applicable*

Note: 〈 ✓ 〉 – *Satisfactory.*

〈 X 〉 – *Equipment is unsafe / in adverse condition. A list of generally agreed unsafe conditions is attached in the Annex of this form. The installation shall be regarded as unsafe if any of those conditions was observed at the time of inspection.*

〈 NA 〉 – *Not applicable.*

〈 D 〉 – *Information to be provided, if any, in Section IIb – Maintenance Record Summary.*

Form 109 revision: 05/2023

Section IIb Maintenance Record Summary

For Item B1 - Maintenance Records, Item C5 - Date of Vaporiser Revalidation and Item E9-Date of Tank Revalidation

(a) Bulk Tanks

		Tank No. 1		Tank No. 2		Tank No. 3	
Serial number							
Last examination date (dd/mm/yyyy)			Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*
PRV manufactured date / last replacement date* (dd/mm/yyyy)			Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*
Cathodic Protection System	**Last test date** (dd/mm/yyyy)		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*
	Second last test date (dd/mm/yyyy)						
Remarks							

** delete as appropriate*

(b) Vaporisers

	Vaporiser No. 1		Vaporiser No. 2		Vaporiser No. 3	
Serial number						
Last examination date (dd/mm/yyyy)		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*
PRV manufactured date / last replacement date* (dd/mm/yyyy)		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*
Remarks						
	Vaporiser No. 4		**Vaporiser No. 5**		**Vaporiser No. 6**	
Serial number						
Last examination date (dd/mm/yyyy)		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*
PRV manufactured date / last replacement date* (dd/mm/yyyy)		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*
Remarks						

** delete as appropriate*

For Item B2 – Alteration Records

There was unauthorised major alteration against original approved plan.	(Yes / No) *

** delete as appropriate*

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For Item D4 - Date of Pipework Test/Inspection

	Underground LPG pipes within Compound/Store		Exposed LPG pipes within Compound/Store	
Date of pressure test (dd/mm/yyyy)		Comply with requirement? (Yes / No)*		
Date of inspection (dd/mm/yyyy)				Comply with requirement? (Yes / No)*

** delete as appropriate*

For Item D5 - Date of HPRV replacement

	Batch No. 1		Batch No. 2		Batch No. 3		Batch No. 4	
Number of HPRV								
HPRV manufactured date / last replacement date* (dd/mm/yyyy)		Comply with requirement? (Yes / No)		Comply with requirement? (Yes / No)		Comply with requirement? (Yes / No)		Comply with requirement? (Yes / No)

** delete as appropriate*

For Item F3 - Date of Replacement of Flexible Gas Tubings

	Batch No. 1		Batch No. 2	
Number of Flexible Gas Tubings				
Last replacement date of flexible gas tubing (dd/mm/yyyy)		Comply with requirement? (Yes / No)*		Comply with requirement? (Yes / No)*

For Item G - Summary of Irregularities Observed/Other Information
(e.g. unsafe/adverse conditions, overdue examination/testing etc.)

Section III Recommendations and Remedial Work

(A) Recommendations by Class 2 Competent Person		(B) Remedial work done by Owner
Checklist Item	**Description**	(Tick if completed or put down planned completion date)#

Note: # Remedial work should be completed as soon as possible and in any case not later than 3 months from the date of inspection. Otherwise, substantiation should be provided. The Gas Authority may conduct follow up inspection on the irregularities.

Form 109 revision: 05/2023

Section IV Overall Comments

Overall Comments	
☐	I am of the opinion that at the time of inspection the above LPG storage installation **was** maintained and operated in a safe condition for the prevention of fire, explosion or other danger arising from the installation.
☐	I am of the opinion that at the time of inspection the above LPG storage installation **was not** maintained and operated in a safe condition.

☐ *Mark「✓」if appropriate*

Section V Declaration

(A) Class 2 Competent Person

1. This is to certify that the above installation was inspected on _____ (Date)

   by _____ (Competent Person) of _____ (Company Name)

   and the foregoing is a correct report of the results of the inspection.

2. The owner has been reminded to complete Section III(B) and V(B), and submit a copy of this report to the Gas Authority, Electrical and Mechanical Services Department **within 4 weeks (i.e. before date: _____) after the inspection**.

Signature：_____Company Chop：_____

(B) Owner

1. I/We hereby submit a copy of the inspection report of the above installation in accordance with Regulation 6C of Part IIA of the Gas Safety (Gas Supply) Regulations, Cap. 51B.

2. I/We understand that this report shall be submitted to the Gas Authority, Electrical and Mechanical Services Department **within 4 weeks after the inspection** and failure to do so is an offence.

Date of Submission：_____ Signature：_____

(Name of authorised representative:)

Contact Telephone No : _____ Email : _____

Explanatory Notes:

1. This report is to be used for annual inspection of LPG storage installation referred to in paragraph (f) of 'notifiable gas installation' interpretation, as stated under Part I Section 2 of the Gas Safety Ordinance, Cap. 51.
2. The owner shall employ a Class 2 competent person to inspect the LPG storage installation annually. The Class 2 competent person should complete appropriate Sections I, II, III(A), IV &V(A) of the report and the owner should complete Sections III(B) & V(B) of the report. The report shall be kept by the owner for the service life of the installation.
3. The owner shall submit a copy of the report to Gas Authority via. Electrical & Mechanical Services Department, 3 Kai Shing Street, Kowloon, Hong Kong by mail, by fax (2576 5945) or by email (gsdb@emsd.gov.hk) within 4 weeks after the inspection.
4. Failure to comply with the requirements of inspection by a competent person, late inspection of the installation and/or late submission of the inspection report is an offence against Regulation 6C(2)(a) & (b) of Gas Safety (Gas Supply) Regulations, Cap 51B. If convicted, the owner is liable to a fine of $5,000. The owner should therefore ensure the submitted report reach the Gas Authority within 4 weeks after the inspection. Report not received by Gas Authority within 4 weeks after the inspection is considered as late submission of the inspection report.
5. The owner shall carry out the necessary remedial work on the LPG storage installation as recommended in the inspection report.

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APPENDIX I SUMMARY OF TESTS, EXAMINATIONS AND INSPECTIONS

Particular	Frequency of Test/Examination/Inspection	Examination/Test/Inspection performed	Reference
Underground/mounded tank	i) At least once in the first 10-year period following initial use, and ii) After expiration of the period referred to in paragraph (i), in the 5-year period immediately preceding continued use.	• Visual internal & external examinations • Hydraulic test • Ultrasonic thickness test • Magnetic particle test • Paint thickness test • Holiday test	11.3.2.2 9.3.2 9.3.1 9.3.1 9.3.1 9.3.1
Aboveground tank with manhole	5 years	• Visual external examination	11.3.2.1
	10 years	• Visual internal & external examinations • Hydraulic test • Ultrasonic thickness test • Magnetic particle test	11.3.2.1 9.3.2 9.3.1 9.3.1
Aboveground tank without manhole	5 years	• Visual external examination	11.3.2.1
	10 years	• Visual external examination • Hydraulic test • Ultrasonic thickness test • Magnetic particle test	11.3.2.1 9.3.2 9.3.1 9.3.1
Aboveground tank with fireproof coating	5 years	• Visual internal & external examination • Hydraulic test • Ultrasonic thickness test • Magnetic particle test	11.3.2.1 9.3.2 9.3.1 9.3.1
Vaporiser	5 years	• Hydraulic test • Functional test	11.3.3.1 9.4.1 & 9.4.2
Pressure relief valve	5 years	• Replaced/reconditioned/ retested	11.3.2.4 11.3.3.2
Cathodic protection system	6 months	• Functional test and inspection	11.3.2.5
Exposed pipework	Annually	• Visual/leak test	11.3.4.1
Pigtails for cylinders	5 years	• Replaced	11.2.7
Hydrostatic pressure relief valve	10 years	• Replaced	11.3.4.3
LPG installation	Annually	• Inspection of site, equipment and maintenance records	11.3.5.2

APPENDIX J RECOMMENDED OPERATIONS AND MAINTENANCE CHECK ITEMS

Suggested Gas Resumption Procedure

The following are sample procedures for resumption of gas supply:

a) Ideally, gain access to all customers and check that all appliances are in the "off" position, or valves upstream of appliances are turned off, and will only be turned on after the appliances are checked.

b) If the above is not feasible, perform pressure test to the riser / downpipe by letting in LPG. Isolate the riser / downpipe observe the pressure. Allow for pressure stabilisation in the first minute, and observe for any pressure drop in the subsequent 2 minutes. If no pressure drop is observed, it can be taken that no appliance is turned on, and gas can safely be resumed.

c) If any pressure drop is observed, the pressure within the riser / downpipe should immediately be vented off. Access should be gained to each customer for checking, and any valve / appliance properly turned off. Repeat the pressure test process until a positive result is obtained before gas supply is resumed.

d) Have staff remain at the scene on stand-by to assist any customer having difficulty with their appliances, or otherwise have a means of contact for customers to seek for assistance.

Draining of Heavy Ends

The following are sample procedures for draining of heavy ends:

a) The drain shall have two valves, separated by approximately 0.5m of pipework. This is to prevent the risk of freezing open of any one valve when LPG liquid rapidly expands resulting in drastic drop in temperature.

b) The upstream valve is fixed to the drain point, and shall be a quick action quarter turn valve. The downstream valve shall be a globe valve to facilitate throttling for flow control.

c) The second valve may be fitted permanently where appropriate. In this case, the outlet of the second valve shall be properly blanked or plugged when not in use.

d) During draining operation, only one of the two valves may be opened at any one time. The upstream ball valve is opened and discharge from the drain fills the pipeline. It is then closed before the downstream valve is opened gradually to let out the heavy ends.

e) Draining operation shall not be conducted within 3m of any water drain.

f) Heavy ends shall be discharged into a proper container. After draining operation is completed, the container shall be properly capped. The heavy ends should be

disposed of as chemical waste through proper procedures. In no case shall the heavy ends be discharged into drains or sewers.

Operational Check Items for NGIs

Daily Checks

a) LPG tank inventory levels (for bulk plants).

b) LPG tank pressure / regulator pressures after monitor and working units.

c) Vaporiser water level.

d) Check for presence of combustible vapour at vaporiser water inlet.

e) Vaporiser temperatures.

f) Rain caps of PRVs and HPRVs in place.

g) Electric power supply normal.

h) Housekeeping – fence / walls / grilles / gates / wire mesh / barbed wires in good conditions; all gates properly locked; no unauthorized items in vicinity of plant.

Monthly Checks

a) Fire extinguishers expiry date, and pressure indication needle.

b) Warning signs and notices.

c) Drainage system and LPG trap.

d) Vent openings of 1st stage regulators.

e) Weeds and overgrown vegetation around the plant.

f) Visual check of water spray heads and gas detector heads (if installed).

g) ESV test operation.

h) Earthing connections, electrical cabling, bonding wires are in good conditions.

i) Water level of tank chambers; pump out water if excessive.

6-Monthly Checks

a) Drain heavy ends from vaporiser and drain pot downstream of 1st stage regulator.

b) Strip and clean 1st stage regulators, check for signs of heavy ends accumulation and deterioration of diaphragm or other rubber elements.

c) Check for any signs of corrosion of pipework.

d) Cathodic protection monitoring (refer to Section 11.3.2.5).

Annual Checks

a) Form 109 inspection (refer to Section 11.3.5.1).

b) WR2 inspection for electrical installations.

c) Integrity of the insulation layer of vaporiser heating elements, by measuring the resistance value between the heating wire and casing.

d) Gas detector system calibration (if fitted).

e) F.S. 251 inspections for fire extinguisher and fire services installations (if fitted).

APPENDIX K RECOMMENDED TRAINING MANUAL OUTLINE

The objective of the training manual is to give the persons engaged in LPG operations the basic knowledge to operate and maintain the LPG compound or cylinder store in safe conditions. In principle, the persons engaged in LPG operation shall:

a) be provided with extensive training in their specific areas of responsibilities;

b) be thoroughly familiar with the properties of LPG;

c) have knowledge of and access to the appropriate codes of practice at all times;

d) have specific guidance on the procedures to be followed under emergency conditions;

e) be familiar with different types of fire-fighting and fire control equipment, including fire extinguishers;

f) ensure that the LPG storage does not exceed its approved quantities; and

g) ensure that all fire extinguishers and LPG equipment are clearly identified for their types and expiry dates.

The following are suggestions on the topics to be covered. These may vary for different types of LPG installations, e.g., LPG compounds, piped cylinder stores, standby cylinder stores, etc. Furthermore, depending on the persons being trained (from manager to operational technicians), some sections may or may not apply, and depth of coverage may differ.

1. Statutory Requirements
    - Gas Safety Ordinance (Cap. 51)
    - Code of Practice for Hong Kong LPG Industry Modules 1, 2, 3 and 7
2. Properties of LPG
3. Responsibilities of NGI owner, Competent Persons, Registered Gas Supply Company and Gas Systems Contractors
    - 3.1 Updated organization charts of various parties
    - 3.2 Updated contact lists
    - 3.3 Responsibilities of various parties
4. LPG Compound / Cylinder Store System
    - 4.1 Updated schematic diagrams
    - 4.2 Updated layout plans
    - 4.3 Equipment list

5. Safe Operating Procedures

5.1 Checklists for routine inspections

- Daily, weekly, monthly, semi-annually inspections
- Proper ways for checking each item and filling out the checklist
- Review system for checklist, and reporting channel for items needing attention

5.2 Procedures for:

- Road tanker unloading
- Proper procedures for changing LPG cylinders
- Access controls
- Valve pits inspections
- Underground pipeline inspections
- Aboveground pipeline inspections
- Draining of heavy ends
- Waste disposal for draining of heavy ends

5.3 Emergency Response Plan, as defined under Code of Practice Module 7

5.4 Permit-to-work system

6. Personal Safety

6.1 Personal protection equipment (PPE)

- Areas where PPE is required – LPG compounds / stores, work sites
- Different types of PPE – understand their function, getting the proper ones, proper wearing of PPE, proper care and maintenance
- Which PPEs are required for specific locations and tasks

6.2 Use of mobile phones and pagers in hazardous areas

- Defined hazardous areas - LPG compounds / stores, around cylinder wagons
- Awareness of other hazardous areas – attending suspected gas leak scene, fire, LPG equipment under repairs

6.3 Portable Flammable Gas Detectors

- Circumstances where portable gas detectors must be used to establish safety before entry / work

- Proper use of portable gas detector – self test in clean atmosphere, bump test if necessary, regular calibration, be alert to situations where detector sensor can be “poisoned”

7. Records

- The training records shall be kept and retained for not less than 2 years.

APPENDIX L SAMPLE GAS FREE CERTIFICATE

Report on Gas Freeing of [specify the equipment – tank/pipeline/vaporiser, etc.] at [location of NGI]

Address of Notifiable Gas installation: _____

I certify that, at the request of [NGI owner], I witnessed the gas freeing of [specify the equipment type, quantity, serial number if applicable] on [date]. My report is as follows:-

Gas-Freeing Exercise

Gas freeing was carried out by [name of person performing the gas freeing] of [name of gas systems contractor] on [date] in accordance with the requirements under the Gas Safety (Gas Supply) Regulations, Code of Practice for Hong Kong LPG Industry Module 1 and [other codes as appropriate, e.g. CoP Module 2]. The objective was to gas free for [specify purpose of gas freeing, e.g. for repair / for abandonment]. The [specify the equipment] has been properly [specify the means to ensure gas free state is subsequently guaranteed, e.g., properly isolated / blanked / removed from site].

Procedures

[briefly describe the steps taken to achieve gas free, and the medium used].

Observations

[describe the observations to support the conclusion of gas free status, e.g., LEL measurement / filled up with water].

Conclusion

[statement confirming that the equipment / system is in a gas free state].

Certified by
Class 1a Competent Person: _____

_____[signature]_____

Company Name: _____

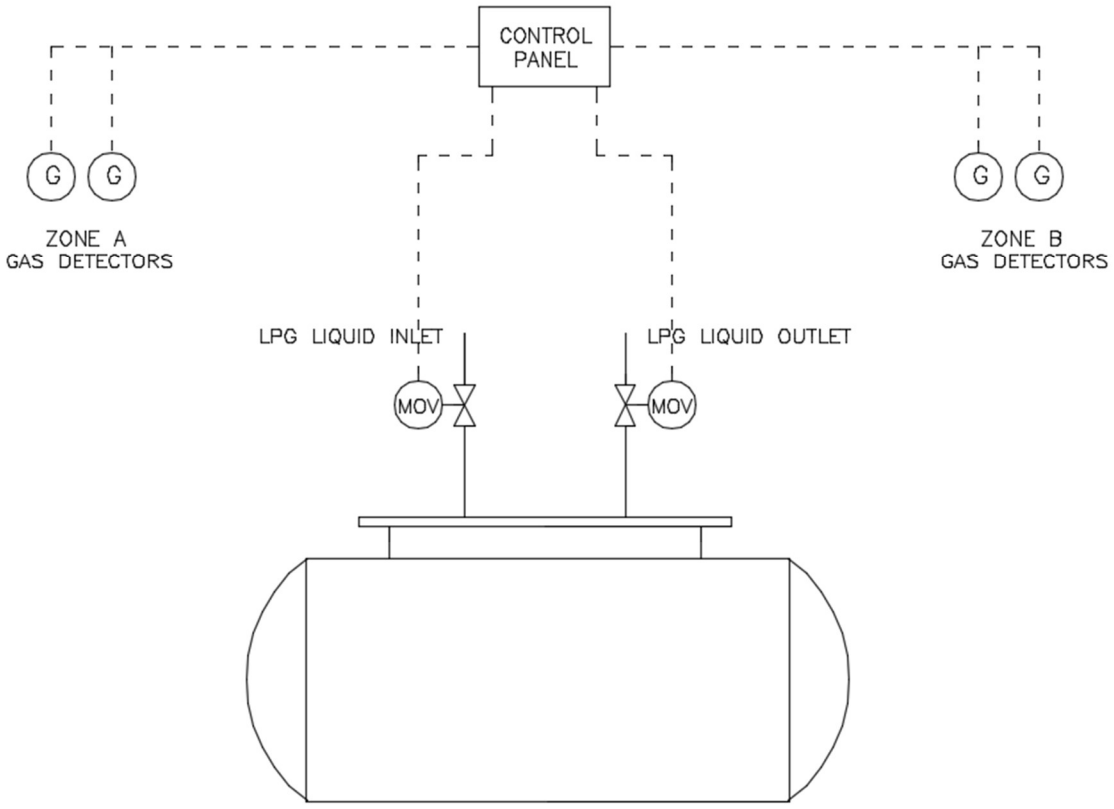
Company Chop: _____

Date: _____

APPENDIX M BEST PRACTICE ON FLAMMABLE GAS DETECTORS LINKED TO MOTOR OPERATED VALVES (MOVs)

This practice balances the need to isolate significant gas leakage and gas supply reliability. One of the operation modes is as follows:

- MOVs fitted only to liquid lines, and in fail-open mode.
- Gas detectors will be installed in two (2) zones: one set at road tanker filling bay (Zone A) and the other set at vaporiser room (Zone B). There should be at least two (2) gas detectors at each zone.
- Gas detectors will generate signals at two (2) levels: a lower "Alarm Level" and a higher "Action Level".
- When any one detector in one zone detects gas leakage at the Alarm Level, an SMS message will be sent to the NGI owner.
- Only when both detectors at any one zone register gas leakage at the Action Level will the MOVs be triggered to close, and an SMS message will be sent to the NGI owner.
- The detailed setting of "Action Level" and "Alarm Level" should take into account the reliability of the system, so as to safeguard gas supply continuity.



Schematic diagram: MOVs are installed at inlet and outlet of the LPG liquid pipework, and they are linked with gas detectors