

DANGEROUS SUBSTANCES AND EXPLOSIVE ATMOSPHERES RISK ASSESSMENT

MOULTON BULB COMPANY LIMITED

24 APRIL 2018



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A handwritten signature in black ink, appearing to read "Mat 2".

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May 2018

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1. Introduction

This report has been produced following a request for assistance by Mr Chris Woodrow (Director), Moulton Bulb Company Limited. The report includes risk assessments based on the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) and its accompanying Approved Code of Practice and Guidance (ACOP), for the delivery, storage and use of Liquefied Petroleum Gas (LPG). Mr Mathew Dean (Health and Safety Advisor, Cope Safety Management Limited) visited the premises on 24 April 2018, met with Mr Woodrow and undertook risk assessments for three bulk LPG installations. The LPG installations are provided for the supply and storage of LPG for refilling forklift trucks, and fuelling heating equipment for stores 4000 and 5000.

DSEAR was made under the Health and Safety at Work etc. Act 1974. The Regulations apply to workplaces in Great Britain and were made to implement two European Directives:

- a) The safety aspects of the Chemical Agents Directive 98/24/EC (CAD); and
- b) The Explosive Atmospheres Directive 99/92/EC (ATEX).

The primary purpose of DSEAR is to protect workers and others who may be at risk from dangerous substances that can cause a fire, explosion or similar energy releasing event, such as a runaway exothermic reaction.

DSEAR and its ACOP are referred to throughout this report. ACOPs are approved by the Health and Safety Executive (HSE) and given consent by the relevant Secretary of State. They are not law but describe preferred or recommended methods that can be used to comply with Regulations. Generally, if employers follow the ACOP, they will be complying with the law. Employers are free to follow other methods but must be able to demonstrate that these comply with the law in some other way.

Although not repeated in its entirety due to its length, this report includes text taken directly from DSEAR, as well as the ACOP, so that readers are aware of what the law and guidance requires in the context of the report. This text is provided in italics. The non-italic text in the report is the author's interpretation and commentary based on current knowledge. The full ACOP can be accessed at <http://www.hse.gov.uk/pubns/priced/l138.pdf>.

Regulations 1 to 11 of DSEAR are covered below, some expanded on more than others depending of the author's perceived level of importance for this report. It is important that these Regulations and the report be read in their entirety.

In addition to the commentary, Appendices A to C of this report include three risk assessments, one undertaken for each installation, Part 1 of each risk assessment summarises the dangerous substances and hazard classification, Part 2 of each risk assessment summarises ignition sources and personal exposure, Part 3 of each risk assessment summarises normal operating procedures, Part 4 of each risk assessment summarises filling operations and Part 5 of each risk assessment summarises maintenance operations. Information is also provided in each risk assessment on existing and possible further control measures. A conclusion is provided in Section 3.

Please note, this report does not consider the potential occupation health effects of the substance(s) in question, or the environmental impacts of their release. Although both aspects are important, a different approach to assessing those risks is required, which is beyond the scope of this report. Notwithstanding, the control measures discussed here may also prove beneficial in the aforementioned areas.

2. The Dangerous Substances and Explosive Atmospheres Regulations 2002

Regulation 1 – Citation and commencement

Regulation 1 indicates that all parts of the Regulations are now in force.

Regulation 2 – Interpretation

Regulation 2 provides a list of definitions giving the exact meanings for terms used. For example, Regulation 2 gives the definition of a "dangerous substance" as including "(a) a substance or preparation which meets the criteria in the approved classification and labelling guide for classification as a substance or preparation which is explosive, oxidising, extremely flammable, highly flammable or flammable ...'.

The definition of explosive atmosphere means "a mixture, under atmospheric conditions, of air and one or more dangerous substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture".

This interpretation is important when considering the hazardous properties of a substance, see Regulation 5 (2)(a) below.

Regulation 3 – Application

To avoid overlaps with other more specific legislation Regulation 3 disapples some named work activities from some individual DSEAR Regulations.

The Regulations are applicable to the delivery, storage and use of LPG at Moulton Bulb Company Limited.

Regulation 4 – Duties under these Regulations

Regulation 4 explains the scope of the Regulations as they apply to the duties of employers and the self-employed who are included within the term 'employer'. Duties to employees and others are outlined including provision of protective equipment and information.

Moulton Bulb Company Limited is an employer. Employees and contractors will access the premises, i.e. for normal work, cleaning and maintenance, deliveries, etc. The premises is set in a rural area of Lincolnshire.

Moulton Bulb Company Limited have a duty to assess and control the risks from dangerous substances. They are also responsible for ensuring the co-ordination and co-operation of contractors, visitors and others who may

be affected by their acts or omissions. It was clear that responsibilities are understood, not least, by arranging this report.

The areas of Moulton Bulb Company Limited operations being considered are to the rear of stores 4000 and 5000, and the forklift truck refilling point.

The maximum number of employees present in the immediate area during operations would be one, i.e. making a delivery to one of the installations or refilling a forklift truck.

Regulation 5 – Risk assessment

Regulation 5 requires all employers and the self-employed to assess all potential risks to employees and others whose safety may be affected by the use of or presence of a dangerous substance at the workplace.

Employers should check that measures are in place before beginning any new work activity or processes and recheck arrangements periodically.

If five or more people are employed, a written record of the significant findings is required. This can either be a separate record or integrated into the record made of overall assessment under the Management of Health and Safety at Work Regulations 1999 or the fire safety regulations.

(1) Where a dangerous substance is or is liable to be present at the workplace, the employer shall make a suitable and sufficient assessment of the risks to his employees which arise from that substance.

(2) The risk assessment shall include consideration of –

(a) the hazardous properties of the substance;

Propane is a highly flammable in liquid and vapour form, with a flashpoint of -104°C. The lower/upper explosive limit (LEL/UEL) in air is 2.2%-9.5% (volume/volume).

There is potential for flammable vapours during the refilling of forklift trucks and during the delivery of LPG to the bulk installations.

Adverse conditions, such as the presence of naked flames, including smoking, and excessive heat, are specifically avoided.

(b) information on safety provided by the supplier, including information contained in any relevant safety data sheet;

A Material Safety Data Sheet for Propane is provided at Appendix A to this report. The actual supplier may vary, however the composition remains constant.

The substance must be kept away from sources of ignition, and precautionary measures must be taken against static discharges.

Vapours of Propane are noted as being heavier than air and may spread along floors.

(c) the circumstances of the work including –

(i) the work processes and the substances used and their possible interactions;

"work processes" means all technical aspects of work involving dangerous substances and includes –

(a) appropriate technical means of supervision,

(b) connecting devices,

(c) control and protection systems,

(d) engineering controls and solutions,

(e) equipment,

(f) materials,

(g) machinery,

(h) plant,

(i) protective systems, and

(j) warning and other communication systems

To help with understanding of the premises and equipment photographs are provided in the risk assessments at Appendices A to C of this report.

Propane is delivered by a tanker, which parks adjacent to the LPG installation being filled. The Propane is transferred into the appropriate tank by connecting a pipe to the top of the tank from the delivery tanker and pumping under pressure. The tanks are located externally and approximately 15m from any building. The Propane in the case of Store 4000/5000 is drawn directly from the relevant tanks to the heating appliances in the respective store through earthed pipes. Propane is fed to forklift trucks via a specifically designed hose and coupling. The refilling process is undertaken by the driver of the forklift, whom are trained and familiar with the procedure.

No delivery operations were being completed at the time of visit.

(ii) the amount of the substance involved;

There are three installations considered in the risk assessments, they are:

- a) The forklift refilling installation which consists of one 4600 litre (water capacity) tank and one 3900 litre (water capacity) tank. The refilling jetty is approximately 10 metres from the tanks and has a proprietary pumping system.
- b) The Store 4000 installation consists of four 4600 litre (water capacity) tanks and two 3900 litre (water capacity) tanks. These directly feed the heating appliances used in Store 4000.
- c) The Store 5000 installation consists of four 4621 litre (water capacity) tanks and one 3965 litre (water capacity) tank. These directly feed the heating appliances used in Store 5000.

(iii) where the work will involve more than one dangerous substance, the risk presented by such substances in combination; and

None observed

(iv) the arrangements for the safe handling, storage and transport of dangerous substances and of waste containing dangerous substances;

The tanker driver is the responsible person for filling the external tanks.

The tanks at Store 4000 and 5000 feed directly in to the respective heaters. The forklift truck refilling installation feeds the refilling point only.

Signage is displayed prohibiting open flames and other ignition sources, such as smoking.

The tank, delivery vehicle and pipework are bonded during Propane delivery to prevent the accumulation of static charges. All equipment is ATEX rated and earthed to prevent the build-up of static charges. No specific measures are taken against static discharge from other causes, i.e. footwear and clothing.

Cleaning, inspection and maintenance of storage tanks is a specialist operation requiring strict procedures.

(d) activities, such as maintenance, where there is the potential for a high level of risk;

Energetic ignition sources associated with maintenance operations, i.e. hot work, would not be expected to be undertaken during delivery or refilling operations. The risk of ignition from an undetected leak or spill cannot be overlooked, however the leak would likely be venting to atmosphere which would reduce the likelihood of a concentration of Propane forming and the LEL being reached.

Maintenance is dealt with under DSEAR. A full visual check is undertaken prior to LPG delivery by the tanker driver. Delivery is not attempted if the installation is considered unsafe.

The fixed electrical installation for the premises has been inspected and tested and documents are available on site to demonstrate this.

Some of the tanks have been inspected. In the case of the forklift refilling point this was undertaken at installation and further testing will be carried out at periodic intervals as prescribed by a competent person. With regards to the remaining tanks, that have not been inspected, the auditor was informed testing is planned for the near future. Records will be held.

Records are kept for deliveries and drawing amounts, and should any discrepancy be noted, it would be investigated to determine if there has been any leak.

(e) the effect of measures which have been or will be taken pursuant to the Regulations;

These are control and mitigation measures covered in Regulation 6 to 11 below and which are identified in the risk assessments at Appendices A to C of this report.

(f) the likelihood that an explosive atmosphere will occur and its persistence;

There is the likelihood of occasional explosive atmospheres during deliveries and refilling. However, such an explosive atmosphere is unlikely to persist once the operation has ceased unless there is a leak.

Poor maintenance and management of the installations would increase the likelihood of undetected leaks. The effect from undetected leaks may be persistent, however with good maintenance, monitoring and visual checks it possible to ensure leaks do not go undetected.

(g) the likelihood that ignition sources, including electrostatic discharges, will be present and become active and effective.

The list of ignition sources¹ are considered in the risk assessments included at Appendices A to C of this report. Fuel and air mixtures of gasses can be ignited with a very small amount of energy. Propane has a minimum ignition energy (MIE) of 0.25mJ. MIE is the minimum energy that can ignite a mixture of a specified flammable material with air or oxygen. An ordinary spark plug has a discharge of 25mJ. The human body can be charged with static electricity, i.e. by the removal of a jacket, at more than 10mJ. The risk assessments consider three potential ignition sources, electrical, mechanical and frictional energy each capable of discharge greater than 10mJ.

(h) the scale of the anticipated effects of a fire or an explosion;

Were a flammable vapour to ignite, persons in close proximity could be seriously injured, i.e. a delivery tanker driver or an operator refilling a forklift truck. An employee completing maintenance may also be seriously injured if suitable precautions are not taken during maintenance. As Propane vapours are heavier than air, vapours may enter drains and channels and travel some distance from the installation. Should such an incident occur, there would likely be damage to the Moulton Bulb Company Limited properties adjacent to the tanks, for examples, Stores 4000 and 5000. These stores are not densely populated.

Given the remote nature of the Moulton Bulb Company Limited site, local properties are unlikely to be affected unless the tank installations themselves ignite. Persons working outside at Moulton Bulb Company Limited and persons outside at adjacent properties may be injured by flying debris.

(i) any places which are or can be connected via openings to places in which explosive atmospheres may occur; and

None observed.

(j) such additional safety information as the employer may need in order to complete the risk assessment.

Formal training documents were not observed to confirm the skills and knowledge of employees, i.e. forklift truck operators, however verbal information provided confirmed understanding and knowledge of the technical aspects of the role. Written operating instructions, including photographs for carrying out tasks were observed to be in place.

¹ Dangerous Substances and Explosive Atmospheres, Dangerous Substances and Explosive Atmospheres Regulations 2002, Approved Code of Practice and guidance, L138, 2nd Edition, HSE Books, 2013

(3) The risk assessment shall be reviewed by the employer regularly so as to keep it up to date ...

(4) Where the employer employs five or more employees, the employer shall record the significant findings of the risk assessment as soon as is practicable after that assessment is made ...

(5) No new work activity involving dangerous substances shall commence unless –

(a) an assessment has been made; and

(b) the measures required by these Regulations have been implemented.

This risk assessments should be reviewed at regular intervals, i.e. annually, sooner if significant changes have taken place or the employer concludes they are no longer valid, as well as following an accident or dangerous occurrence.

Regulation 6 – Elimination or reduction of risks from dangerous substances

Regulation 6 sets out how to eliminate or reduce the risk to people's safety from the presence of dangerous substances by removing or controlling the risks, and by providing measures to limit or mitigate the consequences for people, should an incident occur.

A hierarchy of control measures is set out in Regulation 6 (4) and the measures required to reduce the effects of an incident are listed in Regulation 6 (5). The employer has a duty to provide and maintain the measures.

The measures in Schedule 1 are also an integral part of Regulation 6.

(1) Every employer shall ensure that risk is either eliminated or reduced so far as is reasonably practicable.

(2) In complying with his duty under paragraph (1), substitution shall by preference be undertaken, whereby the employer shall avoid, so far as is reasonably practicable, the presence or use of a dangerous substance at the workplace by replacing it with a substance or process which either eliminates or reduces the risk.

(3) Where it is not reasonably practicable to eliminate risk pursuant to paragraphs (1) and (2), the employer shall, so far as is reasonably practicable, apply measures, consistent with the risk assessment and appropriate to the nature of the activity or operation –

(a) to control risks, including the measures specified in paragraph (4); and

(b) to mitigate the detrimental effects of a fire or explosion or the other harmful physical effects arising from dangerous substances, including the measures specified in paragraph (5).

(4) The following measures are, in order of priority, those specified for the purposes of paragraph (3)(a) –

(a) the reduction of the quantity of dangerous substances to a minimum;

(b) the avoidance or minimising of the release of a dangerous substance;

(c) the control of the release of a dangerous substance at source;

(d) the prevention of the formation of an explosive atmosphere, including the application of appropriate ventilation;

(e) ensuring that any release of a dangerous substance which may give rise to risk is suitable collected, safely contained, removed to a safe place, or otherwise rendered safe, as appropriate;

(f) the avoidance of –

(i) ignition sources including electrostatic discharges; and

(ii) adverse conditions which could cause dangerous substances to give rise to harmful physical effects; and

(g) the segregation of incompatible dangerous substances.

(5) The following measures are those specified for the purposes of paragraph (3)(b) –

(a) the reduction to a minimum of the number of employees exposed;

(b) the avoidance of the propagation of fires and explosions;

(c) the provision of explosion pressure relief arrangements;

(d) the provision of explosion suppression equipment;

(e) the provision of plant which is constructed so as to withstand the pressure likely to be produced by an explosion; and

(f) the provision of suitable personal protective equipment.

(6) The employer shall arrange for the safe handling, storage and transport of dangerous substances and waste containing dangerous substances.

(7) The employer shall ensure that any conditions necessary pursuant to these Regulations for ensuring the elimination or reduction of risk are maintained.

(8) The employer shall, so far as is reasonably practicable, take the general safety measures specified in Schedule 1, subject to those measures being consistent with the risk assessment and appropriate to the nature of the activity or operation.

Schedule 1 is reproduced below.

Schedule 1 - General safety measures

1. The following safety measures are those specified for the purposes of regulation 6(8).

Workplace and work processes

2. Ensuring that the workplace is designed, constructed and maintained so as to reduce risk.

3. Designing, constructing, assembling, installing, providing and using suitable work processes so as to reduce risk.

4. Maintaining work processes in an efficient state, in efficient working order and in good repair.

5. Ensuring that equipment and protective systems meet the following requirements –

(a) where power failure can give rise to the spread of additional risk, equipment and protective systems must be able to be maintained in a safe state of operation independently of the rest of the plant in the event of power failure;

(b) means for manual override must be possible, operated by employees competent to do so, for shutting down equipment and protective systems incorporated within automatic processes which deviate from the intended operating conditions, provided that the provision or use of such means does not compromise safety;

(c) on operation of emergency shutdown, accumulated energy must be dissipated as quickly as possible or isolated so that it no longer constitutes a hazard; and

(d) necessary measures must be taken to prevent confusion between connecting devices.

Organisational measures

6. The application of appropriate systems of work including –

(a) the issuing of written instructions for the carrying out of the work; and

(b) a system of permits to work with such permits being issued by a person with responsibility for this function prior to the commencement of the work concerned,

where the work is carried out in hazardous places or involves hazardous activities.

For the purpose of the risk assessments it is assumed that the presence of Propane cannot be eliminated or substituted with a less hazardous alternative.

Regulation 6 (4) and (5), as well as Schedule 1, are the basis for control measures in the risk assessments included at Appendices A to C of this report.

Written operating instructions, including photographs for carrying out tasks were observed in place.

Permits to work are not completed as standard operating procedures are in place. A permit to work system is recommended for maintenance or non-routine activities.

Regulation 7 – Places where explosive atmospheres may occur.

Regulation 7 contains specific requirements to be applied where an explosive atmosphere may occur (in addition to the requirements in Regulations 5 and 6).

The regulation requires competent identification of hazardous and non-hazardous zones before new work starts and verification by a competent person.

Hazardous places are classified in terms of zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere. Zoning is important when specifying the type of equipment, or the work activities that may be carried in particular areas to prevent ignition.

Zone 0 – A place in which an explosive atmosphere consisting of a mixture with air of a dangerous substance in the form of gas, vapour or mist is present continuously or for long periods. Zone 20 is the equivalent for a cloud of combustible dust.

Zone 1 – A place in which an explosive atmosphere consisting of a mixture with air of a dangerous substance in the form of gas, vapour or mist is likely to occur in normal operation occasionally. Zone 21 is the equivalent for a cloud of combustible dust.

Zone 2 – A place in which an explosive atmosphere consisting of a mixture with air of a dangerous substance in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only. Zone 22 is the equivalent for a cloud of combustible dust.

Zone 0

The interior of tanks at all times and associated pipework during delivery and refilling operations.

Zone 1

The immediate area around the refilling point during refilling.

Zone 2

0.75m (in all directions) around the exterior of the tanks and pipe work at all times.

Regulation 8 – Arrangements to deal with accidents, incidents and emergencies.

Regulation 8 requires employers to protect the safety of employees by forward planning to have in place arrangements to deal with accidents, incidents and emergencies, including the evacuation, escape or rescue of people. The arrangements include first aid, safety drills and testing, information on hazards, warning and response systems and means of escape. These are required unless such measures would be disproportionate to the risk.

The site is relatively isolated. Gates, closed circuit television and exterior lighting all help deter unauthorised access. It was reported that there has been no known occasions of unauthorised access to the site.

In the event of an explosion or a fire starting, alerting persons in the vicinity and then contacting the emergency services would be the priority.

Fire drills are undertaken, however additional emergency plans should be developed to cover the release/suspected release of Propane. Plans need to be communicated and practiced.

Regulation 9 – Information, instruction and training

Appropriate information, training and instruction should be given to contractors and employees on the dangerous substances present together with information on the hazards, risks, precautions and actions necessary for them to remain safe.

There are a limited numbers of employees authorised to use the forklift refilling point or perform maintenance in the vicinity of the installations. enter and operate the Moulton Bulb Company Limited facility. It was reported that these employees have been suitably trained. Formal training documents were not observed to confirm the skills and knowledge of employees, however verbal information provided confirmed understanding and knowledge of the technical aspects of the role. Written operating instructions, including photographs for carrying out tasks were observed to be in place.

Regulation 10 – Identification of hazardous contents of containers and pipes.

Regulation 10 applies to containers and pipes that contain dangerous substances that are not subject to or exempt from any marking requirements in the legislation listed at Schedule 5.

Propane pipe work is marked sporadically around the site.

Regulation 11 – Duty of co-ordination

Regulation 11 addresses the need to co-ordinate explosion protection measures where employers share the same workplace.

Where two or more employers share the same workplace (whether on a temporary or a permanent basis) where an explosive atmosphere may occur, the employer responsible for the workplace shall co-ordinate the implementation of all the measures required by these Regulations to be taken to protect employees from any risk from the explosive atmosphere.

The site is operated by Moulton Bulb Company Limited.

Regulations 12 to 17 are not relevant to the understanding of the basic principles of DSEAR and are therefore omitted from this report.

3. Conclusions

Propane is a dangerous substance within the context of DSEAR, in that it could form a dangerous concentration with air during delivery, the refilling of forklift trucks or in the event of a leak occurring.

It was noted that the company, and Mr Chris Woodrow, understand the need to remove or reduce the risks and ensure the health, safety and welfare of those who are, or are potentially, affected by the operation.

Moulton Bulb Company Limited are controlling the risks by isolating the tank installations, so far as is reasonably practicable, and limiting the exposure of employees and others to the lowest number possible. Furthermore, those employees and other persons are suitably trained, competent and hold the appropriate licenses.

The tank installations were installed by competent persons using the standards in place at that time. Where the use of electricity is necessary, such as the forklift truck refilling point, ATEX rated equipment has been installed. The electrical installation is under a regime of periodic inspection and testing.

By implementing the control measures identified within the Action Plans of the risk assessments at Appendices A to C, Moulton Bulb Company Limited will reduce the risk further.

APPENDICES

Appendix A

DSEAR Risk Assessment – LPG storage and dispensing of LPG for refilling forklift trucks

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage and dispensing of LPG for refilling forklift trucks		
System Description:	1 x 4600 litre (water capacity) tank and 1 x 3900 litre (water capacity) tank with a dispensing point on a jetty		
Part 1:	Dangerous Substances & Hazardous Area Classification	Location:	Outdoors

DANGEROUS SUBSTANCES CHARACTERISTICS										
Substance Name	Composition	Phase (gas / liquid)	Flammable Limits (in air)		Flash Point (°C)	Density (water = 1)	Gas Relative Density (air = 1)	Auto Ignition Temperature (°C)	Group & Temperature Class	Minimum Ignition Energy (mJ)
			LEL (%)	UEL (%)						
Propane	100%	Liquid	2.2	9.5	-104	0.56	1.56	470	IIA T1	0.25

Potential Release Source	Location	Likelihood of release	Dangerous Substances Operating Conditions		Ventilation		Hazardous Area			Remarks
			Pressure (barg)	Temperature (°C)	Type	Degree / Availability	Zone Type (0-1-2)	Zone Extent Vert. (M)	Zone Extent Horiz. (M)	
Venting Fill Hose	External	1	7	Ambient	Natural	VL	2	0.75*	0.75*	Hose checked prior to refilling by employees.
Safety Valves	External	1	7	Ambient	Natural	VL	2	0.75*	0.75*	Valves are designed and manufactured for purpose. No documented emergency plan for the site [Action Plan Ref 1].
Mechanical Joint Failure	External	1	7	Ambient	Natural	VL	2	0.75*	0.75*	System has recently been installed and an inspection schedule is in place.
Pressure Accessories. Valves, Regulators, Filter, Gauges, Etc.	External	1	7	Ambient	Natural	VL	2	0.75*	0.75*	Accessories are designed, manufactured tested and appropriate for gas. Valves on top of the tank are not afforded protection [Action Plan Ref 2, Photo 1].
Relief Valve Fails to Open	External	1	7	Ambient	Natural	VL	2	0.75*	0.75*	System has recently been installed and an inspection schedule is in place.
Tank Shell Corrosion	External	1	7	Ambient	Natural	VL	2	0.75*	0.75*	System has recently been installed and an inspection schedule is in place. Tanks appear to have been painted which may mask signs of corrosion. Tank specification plates displayed. Written scheme of examination documented.
Puncture (FLT)	External	1	7	Ambient	Natural	VL	2	0.75*	0.75*	Tanks are positioned approximately 5 metres from road way and are afforded both Armco and palisade fencing. Forklift truck refilling point is approximately 10 metres away.
Tank Failure	External	0	7	Ambient	Natural	VL	2	0.75*	0.75*	Tanks are manufactured to recognised specification and have been inspected following relocation.
Hose Failure Including Assembly	External	0	7	Ambient	Natural	VL	2	0.75*	0.75*	Hose is visually inspected by employees and has recently been installed by competent contractor. Hose is designed for intended use.
Hose Failure – Drive Away	External	1	7	Ambient	Natural	VL	2	0.75*	0.75*	Forklift truck refilling point is fitted with a separation device. Safe system of work in place which has been communicated to all affected employees.

Potential Release Source	Location	Likelihood of release	Dangerous Substances Operating Conditions		Ventilation		Hazardous Area			Remarks
			Pressure (barg)	Temperature (°C)	Type	Degree / Availability	Zone Type (0-1-2)	Zone Extent Vert. (M)	Zone Extent Horiz. (M)	
Failure of Pipework	External	0	7	Ambient	Natural	VL	N/A			Pipework is designed and manufactured in accordance with recognised standards. An inspection schedule is in place. Written scheme of examination documented.

*IGEM – SR – 25 Secondary Releases

DEFINITIONS

LIKELIHOOD OF RELEASE

3 = Continuous (permanent or long periods of release to atmosphere during normal operation)
 2 = Primary (release expected during normal operation)
 1 = Secondary (release NOT expected during normal operation)
 0 = Probability considered negligible, DSEAR risk assessment not required

VENTILATION - TYPE

Natural = Open air
 or, Open building with vents in walls/roof designed with regard to relative density of gas/vapour equivalent to open-air
 or, Building that is not open but with permanent natural ventilation openings

Artificial = General or local means of air movement/air replacement within a building or open air to aid/control product dispersal

VENTILATION - DEGREE

Degree and availability influences the effectiveness of controlling dispersion and persistence of the explosive atmosphere classified as follows:

VH = High ventilation (can reduce concentration virtually instantly to below LEL, resulting in negligible zone extent, but subject to ventilation availability/reliability)
 VM = Medium ventilation (can control concentration whilst release in progress to give stable zone, and explosive atmosphere does not exist after release stopped)
 VL = Low ventilation (CANNOT control concentration whilst release in progress, and/or cannot prevent persistence of explosive atmosphere after release stopped)

ZONE TYPE

Based upon the likelihood of presence of explosive atmosphere dependent upon the grade of release and ventilation (according to EN60079-10)

0 = Where an explosive atmosphere is present continuously / for long periods / frequently (normally 'continuous' grade of release)
 1 = Where an explosive atmosphere is likely to occur in normal operation occasionally (normally 'primary' grade of release)
 2 = Where an explosive atmosphere is NOT likely to occur in normal operation, but if it does, will persist for a short period only (normally 'secondary' grade of release)

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage and dispensing of LPG for refilling forklift trucks		
System Description:	1 x 4600 litre (water capacity) tank and 1 x 3900 litre (water capacity) tank with a dispensing point on a jetty		
Part 2:	Ignition Sources & Personnel Exposure	Location:	Outdoors

Ignition Sources Category	Ignition Source	Likelihood of Ignition Sources Occurring			Remarks
		Normal Operation	Filling Operations	Maintenance Operations	
Heat Energy					
	Internal Combustion Engines	1	1	0	Main site road is approximately 5 metres from bulk tanks with a car park situated to the right hand side of the installation.
	Smoking / Naked Flames	0	0	1	No fire extinguishing media is provided in close proximity of the refilling point [Action Plan Ref 7].
	Hot Work (e.g. Welding)	0	0	1	Hot surfaces, sparks, flame.
	Hot Surfaces	0	0	1	Hot surfaces, sparks, flame.
	Laser / Intense Radiation Sources	1	1	1	LPG tank appears to have been painted [Action Plan Ref 3, Photo 2].
Mechanical Energy					
	Friction / Overheating	0	0	0	
	Ultrasonic	0	0	0	
	Impact	1	1	1	Hot surface due to friction.
	FLT / Vehicle Impact (Puncture)	1	1	0	FLT refilling point is approximately 10 metres away from tanks.
	Grinding	0	0	1	
	Compression	0	0	0	
	(LPG Ingress into Engine – Over Speed Failure)	1	1	0	Engines are switched off during refilling. Drivers trained in procedures.
Chemical Energy					
	Self-Heating	0	0	0	
	Impact / Heat Sensitive Materials	0	0	0	
	Runaway / Exothermic Reaction	0	0	0	
Electrical Energy					
	Electrical Lighting	1	1	1	Flood lights are installed on the exterior of the adjacent building which is approximately 13 metres away.
	Electromagnetic Radiation	0	0	0	
	Short Circuit	1	1	1	Electrical sparks or heat.
	Electrical Arc	1	1	1	Electrical sparks or heat.
	Earth Fault	1	1	1	Electrical sparks or heat.
	Conductor Fault	1	1	1	Electrical sparks or heat.
	Lightning Strike	1	1	1	
	Static Electrical Discharge	1	1	1	Sparks.
	Sparking – Loose Contactors on Vehicles	1	1	1	Electrical sparks or heat.
	Excessive Temperature Rise Due to Overload of Equipment	0	0	1	Heat.
	Induction Heating	0	0	0	
	Resistive Heating	0	0	0	
	Connection to Inappropriate Electrical Supply	0	0	0	

DEFINITIONS LIKELIHOOD OF IGNITION SOURCE OCCURRING

3 = Present continuously or for long periods (>1000 hours / year)
2 = Likely to occur (>10 < 1000 hour / year)
1 = Not likely to occur or infrequent and for short periods (<10 hours / year)
0 = Not present

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage and dispensing of LPG for refilling forklift trucks		
System Description:	1 x 4600 litre (water capacity) tank and 1 x 3900 litre (water capacity) tank with a dispensing point on a jetty		
Part 3:	Risk Assessment – Normal Operations	Location:	Outdoors

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequences of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2					
Internal Combustion Engines	1	1	1	Localised fire, confined to FLT involved, possible injury to vehicle driver.	M	P4	Road way situated approximately 5 metres from installation. Vehicles are switched off during refilling procedure. Drive off protection fitted to hose coupling.	
Laser / Intense Radiation Sources	1	1	1		L	P5	Tanks are designed and manufactured to recognised specification.	LPG tank appears to have been painted [Action Plan Ref 3, Photo 2].
Impact	1	1	1	Localised fire.	L	P5	Both Armco and palisade fencing is erected to protect the tank enclosure, refilling point and pipe work.	
FLT / Vehicle Impact (Puncture)	1	1	1	Major fires, possible knock on effect. Possible injury to FLT driver. Possible explosion.	M	P4	FLT refilling point is approximately 10 metres from tanks. Procedures / driver training in place.	
Internal Combustion Engine (LPG Ingress into Engine – Over Speed Failure)	1	1	1	Damage to vehicle.	M	P4	Proximity of vehicle to release.	
Electrical Lighting	1	1	1	Localised fire, possible injury to maintenance personnel.	M	P4	Lighting is situated over 13 metres away and at height.	
Short Circuit	1	1	1	Localised fire, confined to equipment involved.	L	P5	Suitable ATEX rated pumps and controls installed and maintained.	
Electric Arc	1	1	1	Localised fire, possible explosion, damage to adjacent building or vehicles.	L	P5	Suitable ATEX rated pumps and controls installed and maintained.	
Earth Fault	1	1	1	Localised fire, possible explosion, damage to adjacent building or vehicles.	M	P4	Suitable earthing strips installed and maintained.	
Conductor Fault	1	1	1	Localised fire, possible explosion, damage to adjacent building or vehicles.	L	P5	Suitable ATEX rated pumps and controls installed and maintained.	

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequences of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2					
Lightning Strike	1	1	1	Major localised damage.	L	P5	No evidence of this occurring. Surrounding buildings may offer protection to tanks.	
Static Electrical Discharge	1	1	1	Localised fire.	L	P5	Earthing strips provided for tanks. Earth clamp provided for attachment to forklift. Appropriate Personal Protective equipment provided.	Signage on PPE container requires relocation [Action Plan Ref 5, Photo 3 / 3a].
Sparking – Loose Contactors on Vehicles	1	1	1	Damage to vehicle.	L	P5	FLT's are maintained. Roadway is approximately 5 metres from tanks and FLT refilling point is approximately 10 metres from tanks.	

DEFINITIONS

Severity

H = Major impact or major injury/fatality / M = Serious impact or lost time injury / L = Minor impact or First aid case

Risk Definitions

P1 = Intolerable risk - work must not be started or continued until the risk has been reduced to an acceptable level

P2 = Substantial risk which must be improved through risk reduction methods

P3 = Moderate risk efforts should be made to reduce the risk within a defined time period

P4 = Risk is considered tolerable no additional controls required monitoring is required to ensure controls are maintained

P5 = No action required

	L	M	H	
Likelihood	P3	P2	P1	6 - 9
	P4	P3	P2	3 - 5
	P5	P4	P3	1 - 2
	Severity			
	MATRIX			

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage and dispensing of LPG for refilling forklift trucks		
System Description:	1 x 4600 litre (water capacity) tank and 1 x 3900 litre (water capacity) tank with a dispensing point on a jetty		
Part 4:	Risk Assessment – Filling of FLT Operations	Location:	Outdoors

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequence of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2			See Table Below		
Internal Combustion Engines	1	2	2	Localised fire, confined to FLT involved, possible injury to vehicle driver.	L	P5	FLT refilling point is approximately 10 metres from bulk tanks. Isolation points provided. Flow of LPG controlled by driver using hold to run system. Vehicles switched off during refilling procedure. Drive off protection fitted to hose coupling.	Fire fighters switch located approximately 10 metres from refilling point. The switch location is not immediately identifiable [Action Plan Ref 6. Photo 4 / 4a / 4b].
Laser / Intense Radiation Sources	1	1	1		L	P5	Tanks are designed and manufactured to recognised specification.	LPG tank appears to have been painted [Action Plan Ref 3, Photo 2].
Impact	1	1	1	Localised fire, injury to driver.	L	P5	Driver training, procedures, Armco, adequate space to manoeuvre.	
FLT / Vehicle Impact (Puncture)	1	1	1	Major fires, possible knock on effect. Possible injury to FLT driver. Possible explosion.	M	P4	FLT refilling point is approximately 10 metres from tanks. Procedures / driver training.	
Internal Combustion Engine (LPG Ingress into Engine – Over Speed Failure)	1	1	1	Damage to vehicle.	L	P5	Engine switched off during refilling.	
Short Circuit	1	1	1	Localised fire, confined to equipment involved.	L	P5	Suitable ATEX rated pumps and controls installed and maintained.	
Electric Arc	1	1	1	Localised fire, possible damage to vehicle.	L	P5	Suitable ATEX rated pumps and controls installed and maintained.	

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequence of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2			See Table Below		
Earth Fault	1	1	1	Localised fire, possible damage to vehicle.	L	P5	Earthing clamp used, procedures.	
Conductor Fault	1	1	1	Localised fire, possible explosion, damage to adjacent building or vehicles.	M	P4	Suitable ATEX rated pumps and controls installed and maintained.	
Lightning Strike	1	1	1	Major localised damage.	M	P4	No evidence of this occurring. Surrounding buildings may offer protection to tanks.	
Static Electrical Discharge	1	1	1	Localised fire, possible damage to vehicle.	L	P5		
Sparking – Loose Contactors on Vehicles	1	1	1	Damage to vehicle.	L	P5	Roadway is approximately 10 metres from refilling point. FLT's maintained.	

DEFINITIONS

Severity

H = Major impact or major injury/fatality / M = Serious impact or lost time injury / L = Minor impact or First aid case

Risk Definitions

P1 = Intolerable risk - work must not be started or continued until the risk has been reduced to an acceptable level

P2 = Substantial risk which must be improved through risk reduction methods

P3 = Moderate risk efforts should be made to reduce the risk within a defined time period

P4 = Risk is considered tolerable no additional controls required monitoring is required to ensure controls are maintained

P5 = No action required

Likelihood	L	M	H	
	P3	P2	P1	6 - 9
	P4	P3	P2	3 - 5
	P5	P4	P3	1 - 2
				Severity
MATRIX				

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage and dispensing of LPG for refilling forklift trucks		
System Description:	1 x 4600 litre (water capacity) tank and 1 x 3900 litre (water capacity) tank with a dispensing point on a jetty		
Part 5:	Risk Assessment – Maintenance Operations	Location:	Outdoors

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequence of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2			See Table Below		
Smoking / Naked Flames	1	1	1	Localised fire, confined to location, possible explosion.	M	P4	Site is no smoking throughout with no evidence of unauthorised smoking.	Zoning information is only provided on Flogas information at refilling point and on tanks [Action Plan Ref 4]. No permit to work system in place for work activities [Action Plan Ref 8]. No fire extinguishing media in close proximity of refilling point [Action Plan Ref 7].
Hot Work, e.g. Welding	1	1	1	Localised fire, possible explosion.	M	P4	Competent contractor used for maintenance tasks.	No permit to work system in place for work activities [Action Plan Ref 8]. No fire extinguishing media in close proximity of refilling point [Action Plan Ref 7].
Hot Surfaces	1	1	1	Localised fire, explosion.	L	P5	Competent contractors utilised.	No permit to work system in place for work activities [Action Plan Ref 8]. No fire extinguishing media in close proximity of refilling point [Action Plan Ref 7].
Laser / Intense Radiation Sources	1	1	1	Localised fire.	M	P4	Tanks are designed to specification.	Tanks appear to have been painted [Action Plan Ref 3, Photo 2].
Impact	1	1	1	Localised fire, injury to driver.	L	P5	Driver training, procedures, Armco, adequate space to manoeuvre.	
Grinding	1	1	1	Localised fire, possible explosion.	M	P4	Competent contractor used for maintenance tasks.	No permit to work system in place for work activities [Action Plan Ref 8]. No fire extinguishing media in close proximity of refilling point [Action Plan Ref 7].

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequence of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2			See Table Below		
Electrical Lighting	1	1	1	Localised fire, equipment damage.	L	P5	Competent contractors utilised.	Lights may be used during maintenance operations.
Short Circuit	1	1	1	Localised fire, damage to equipment.	L	P5	Equipment is used as intended and is designed to recognised standard.	
Electrical Arc	1	1	1	Localised fire, damage to equipment.	L	P5	Competent contractors utilised. Earthing strips fitted.	
Earth Fault	1	1	1	Localised fire, explosion.	L	P5	Earthing strips fitted.	
Conductor Fault	1	1	1	Localised fire, possible explosion, damage to adjacent building or vehicles.	L	P5	Suitable ATEX rated pumps and controls installed and maintained.	
Lightning Strike	1	1	1	Major localised damage.	M	P4	No evidence of this occurring. Surrounding buildings may offer some protection.	
Static Electrical Discharge	1	1	1	Localised fire.	L	P5	Earthing strips fitted.	
Sparking – Loose Contactors on Vehicles	1	1	1	Localised fire, damage to vehicles.	L	P5	Earthing strips fitted. Vehicles maintained. Vehicle access limited to refilling and maintenance vehicles.	
Excessive Temperature Rise Due to Overload of Equipment	1	1	1	Localised fire, explosion.	L	P5	Maintenance operatives present.	

DEFINITIONS

Severity

H = Major impact or major injury/fatality / M = Serious impact or lost time injury / L = Minor impact or First aid case

Risk Definitions

P1 = Intolerable risk - work must not be started or continued until the risk has been reduced to an acceptable level

P2 = Substantial risk which must be improved through risk reduction methods

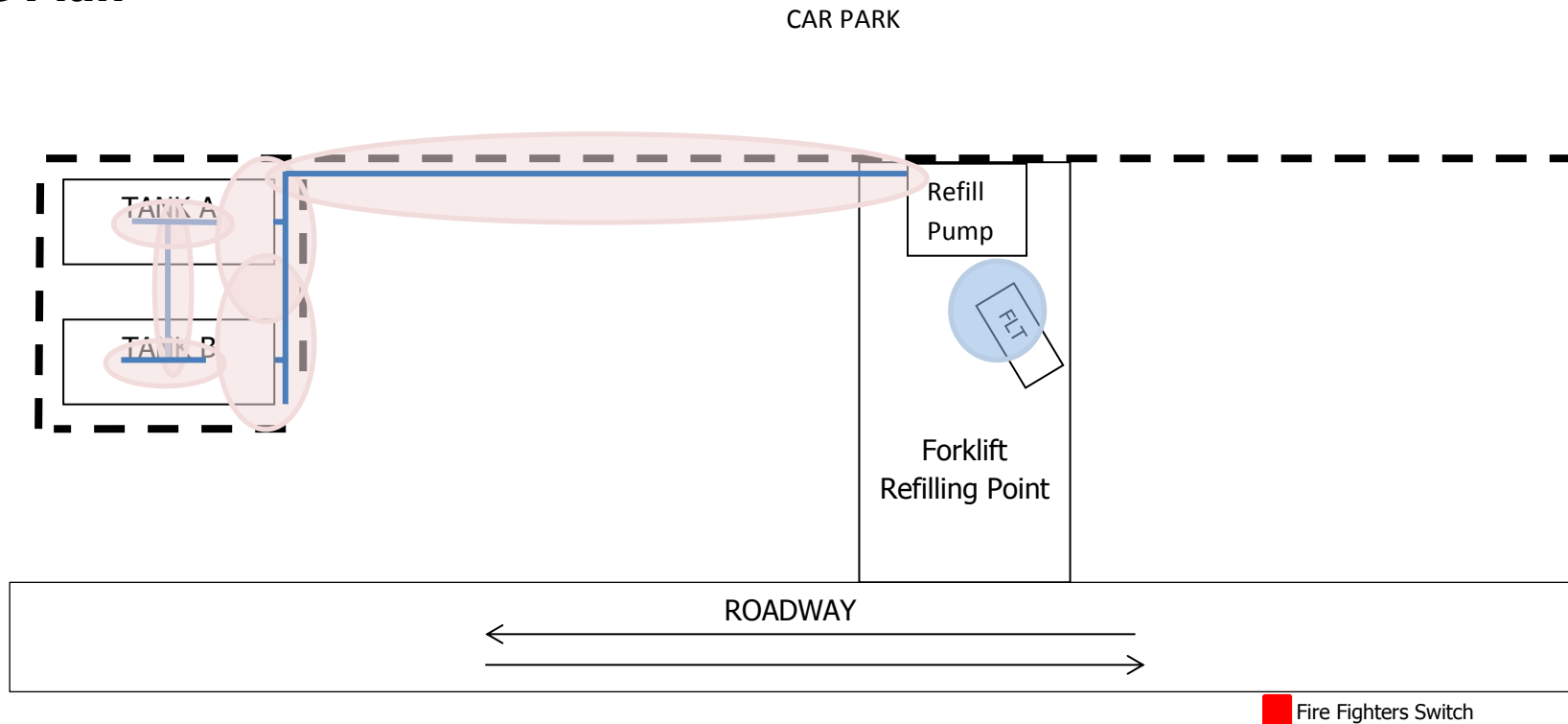
P3 = Moderate risk efforts should be made to reduce the risk within a defined time period

P4 = Risk is considered tolerable no additional controls required monitoring is required to ensure controls are maintained

P5 = No action required

Likelihood	L	M	H	
	P3	P2	P1	6 - 9
	P4	P3	P2	3 - 5
	P5	P4	P3	1 - 2
				Severity
MATRIX				

Zone Plan



Temporary Zone 1 for a radius of 0.5 metres in all directions around coupling break points or bleed point.

(Reference from Guide to Good Industry Practices for Bulk LPG Installations (p41, Table 7)

0.75 metre Zone 2 around pipe work in all directions.

(Reference IGEM SR 25)

**** Not to scale**

ACTION PLAN							
Ref	Hazard	Persons at Risk	Existing Controls	Proposed Controls	Timescale	Responsibility	Date Complete
1	There is no documented emergency plan for the site.	Employees, contractors, visitors	Fire Marshals on site, fire fighters switch provided.	Document emergency plan including site map detailing isolation points. Communicate plan to all affected persons. Practice.	6 months	Chris Woodrow	
2	Valves on top of the tank are not afforded protection [Photo 1].	Employees, contractors, visitors	Access to the site is controlled, CCTV.	Replace valve covers to prevent weather damage / malicious tampering.	1 month	Chris Woodrow	
3	LPG tank appears to have been painted [Photo 2].	Employees, contractors, visitors	Tanks have been inspected by competent external contractor.	Consult competent contractor to determine adverse effects of painting.	1 month	Chris Woodrow	
4	Zoning information is only provided on Flogas information at refilling point and on tanks.	Employees, contractors, visitors	Zone information provided at refilling point.	Erect visible zoning signs on tank fencing.	1 month	Chris Woodrow	
5	Signage on PPE container requires relocation [Photo 3 / 3a].	Employees	Procedures, employee training.	Re-orientate current signage.	1 month	Chris Woodrow	
6	Fire fighters switch located approximately 10 metres from refilling point. The switch location is not immediately identifiable [Photo 4, 4a, 4b].	Employees, contractors, visitors	Fire fighters switch erected. Fire marshals on site.	Sign fire fighters switch to allow prompt identification by persons unfamiliar with site.	1 month	Chris Woodrow	
7	No fire extinguishing media is provided in close proximity of the refilling point.	Employees, contractors, visitors	Firefighters switch in proximity.	Install appropriate firefighting media in proximity of refilling point.	1 month	Chris Woodrow	
8	No permit to work system in place for work activities.	Employees, contractors, visitors	Maintenance work undertaken by competent contractors.	Implement a permit to work system for maintenance activities.	1 month	Chris Woodrow	



Photo 1



Photo 2



Photo 3



Photo 3a



Photo 4

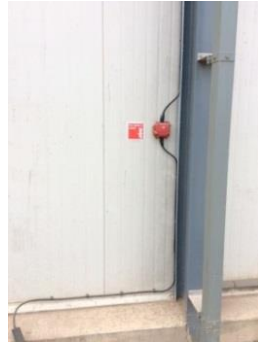


Photo 4a



Photo 4b

Appendix B

DSEAR Risk Assessment – LPG storage for heating of Store 4000

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage for heating of Store 4000		
System Description:	2x 3900 litre (water capacity) tanks and 4 x 4600 litre (water capacity) tanks		
Part 1:	Dangerous Substances & Hazardous Area Classification	Location:	Rear of Store 4000

DANGEROUS SUBSTANCES CHARACTERISTICS

Substance Name	Composition	Phase (gas / liquid)	Flammable Limits (in air)		Flash Point (°C)	Density (water = 1)	Gas Relative Density (air = 1)	Auto Ignition Temperature (°C)	Group & Temperature Class	Minimum Ignition Energy (mJ)
			LEL (%)	UEL (%)						
Propane	100%	Liquid	2.2	9.5	-104	0.56	1.56	470	IIA T1	0.25

Potential Release Source	Location	Likelihood of Release	Dangerous Substances Operating Conditions		Ventilation		Hazardous Area			Remarks
			Pressure (barg)	Temperature (°C)	Type	Degree / Availability	Zone Type (0-1-2)	Zone Extent Vert. (M)	Zone Extent Horiz. (M)	
Leaking Valve Outlet (Damaged Valve Seat)	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	Tank accessories are designed and manufactured to recognised specification. Inspections have not been undertaken [Action Plan Ref 1, Photo 1]. Valve protection covers are not secured [Action Plan Ref 2, Photo 2]. Cylinder LPG cage is within separation distance of first LPG tank [Action Plan Ref 16, Photo 14].
Safety Valve	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	No emergency plan is documented for the release of LPG [Action Plan Ref 3].
Relief Valve Fails to Open	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	
Tank Shell Corrosion	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	20 year inspections are due on a number of tanks [Action Plan Ref 1]. Tanks appear to have been painted which may mask signs of corrosion [Action Plan Ref 4, Photo 3]. Tank specification plates displayed.
Joints Failure. Leaks, Corrosion, Etc.	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	Some connectors are showing signs of rust [Action Plan Ref 5, Photo 4]. LPG cage is situated within the bulk storage tank compound, to retrieve cylinders pipe work must be negotiated increasing risk of damage [Action Plan Ref 6, Photo 5].
Puncture (FLT)	External	0	1.4	Ambient	Natural	VL	2	0.75*	0.75*	Forklift trucks do not visit the area since the relocation of the filling points.
Pressure Accessories. Valves, Regulators, Gauges	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	Some gauge faces are obscured by Verdigris [Action Plan Ref 7, Photo 6]. Shut off valves are not signed [Action Plan Ref 8, Photo 7].
Valve Packing – Bubble Leak	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	20 year inspections are due, some joints are showing signs of rust [Action Plan Ref 1].

Potential Release Source	Location	Likelihood of release	Dangerous Substances Operating Conditions		Ventilation		Hazardous Area			Remarks
			Pressure (barg)	Temperature (°C)	Type	Degree / Availability	Zone Type (0-1-2)	Zone Extent Vert. (M)	Zone Extent Horiz. (M)	
Failure of Pipe Work	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	Pipe work appears to have been painted which may obscure signs of corrosion [Action Plan Ref 9, Photo 8]. Barriers erected to protect pipe work leading to stores. Internally LPG pipe work is sporadically identified [Action Plan Ref 10, Photo 9]. LPG cylinder cage is positioned in such a way that a feed pipe to store 4000 could potentially be damaged [Action Plan Ref 6, Photo 5]. Externally pipe work appears to be shielded in plastic sheathing however it was not possible to determine if this continues underground [Action Plan Ref 15, Photo 13].

DEFINITIONS

LIKELIHOOD OF RELEASE

- 3 = Continuous (permanent or long periods of release to atmosphere during normal operation)
- 2 = Primary (release expected during normal operation)
- 1 = Secondary (release NOT expected during normal operation)
- 0 = Probability considered negligible, DSEAR risk assessment not required

VENTILATION - TYPE

Natural = Open air
or, Open building with vents in walls/roof designed with regard to relative density of gas/vapour equivalent to open-air
or, Building that is not open but with permanent natural ventilation openings

Artificial = General or local means of air movement/air replacement within a building or open air to aid/control product dispersal

VENTILATION - DEGREE

Degree and availability influences the effectiveness of controlling dispersion and persistence of the explosive atmosphere classified as follows:

- VH = High ventilation (can reduce concentration virtually instantly to below LEL, resulting in negligible zone extent, but subject to ventilation availability/reliability)
- VM = Medium ventilation (can control concentration whilst release in progress to give stable zone, and explosive atmosphere does not exist after release stopped)
- VL = Low ventilation (CANNOT control concentration whilst release in progress, and/or cannot prevent persistence of explosive atmosphere after release stopped)

ZONE TYPE

Based upon the likelihood of presence of explosive atmosphere dependent upon the grade of release and ventilation (according to EN60079-10)

- 0 = Where an explosive atmosphere is present continuously / for long periods / frequently (normally 'continuous' grade of release)
- 1 = Where an explosive atmosphere is likely to occur in normal operation occasionally (normally 'primary' grade of release)
- 2 = Where an explosive atmosphere is NOT likely to occur in normal operation, but if it does, will persist for a short period only (normally 'secondary' grade of release)

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage for heating of Store 4000		
System Description:	2x 3900 litre (water capacity) tanks and 4 x 4600 litre (water capacity) tanks		
Part 2:	Ignition Sources & Personnel Exposure	Location:	External

Ignition Sources Category	Ignition Source	Likelihood of Ignition Sources Occurring			Remarks
		Normal Operation	Filling Operations	Maintenance Operations	
Heat Energy					
	Heating Installations	1	0	1	LPG storage tanks provide fuel for heating systems stored internally.
	Internal Combustion Engines	0	1	1	Filling operation undertaken by an external contractor which arrives in a vehicle.
	Smoking / Naked Flames	0	0	1	
	Hot Work (e.g. Welding)	0	0	1	
	Hot Surfaces	0	0	1	
	Laser / Intense Radiation Sources	1	1	1	Tanks are external. Two of the tanks appear to have been painted [Action Plan Ref 4].
Mechanical Energy					
	Friction / Overheating	0	0	0	
	Ultrasonic	0	0	0	
	Impact	1	1	1	Vehicles are seldom in the vicinity however contractors and employees may require to use vehicles.
	FLT / Vehicle Impact (Puncture)	1	0	1	Vehicles are seldom in the vicinity however employees may require to use vehicles.
	Grinding	0	0	1	Grinding may occur during maintenance activities.
	Compression	0	0	0	
Chemical Energy					
	Self-Heating	0	0	0	
	Impact / Heat Sensitive Materials	0	0	0	
	Runaway / Exothermic Reaction	0	0	0	
Electrical Energy					
	Electrical Lighting	0	0	1	Lights may be used during maintenance operations. Internally an emergency light bulk head was observed to be damaged [Action Plan Ref 13, Photo 11].
	Electromagnetic Radiation	0	0	0	
	Short Circuit	1	0	1	Electrical sparks or heat. Internally IP socket covers were noted to be missing at several locations [Action Plan Ref 14, Photo 12].
	Electrical Arc	0	0	1	Earthing strips suitably installed.
	Earth Fault	1	1	1	Earthing strips installed.
	Conductor Fault	0	0	0	
	Lightning Strike	1	1	1	
	Static Electrical Discharge	1	1	1	
	Sparking – Loose Contactors on Vehicles	1	1	1	Vehicles are maintained.
	Excessive Temperature Rise Due to Overload of Equipment	0	0	0	
	Induction Heating	0	0	0	
	Resistive Heating	0	0	0	

DEFINITIONS**LIKELIHOOD OF IGNITION SOURCE OCCURRING**

3 = Present continuously or for long periods (>1000 hours / year)

2 = Likely to occur (>10 < 1000 hour / year)

1 = Not likely to occur or infrequent and for short periods (<10 hours / year)

0 = Not present

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage for heating of Store 4000		
System Description:	2x 3900 litre (water capacity) tanks and 4 x 4600 litre (water capacity) tanks		
Part 3:	Risk Assessment – Normal Operations	Location:	External

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequences of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2					
Heating Installations	1	1	1	Localised fire, damage to equipment, possible injury to employee.	L	P5		
Laser / Intense Radiation Sources	1	1	1		L	P5	Tanks are designed and manufactured to recognised specification.	Tanks appear to have been painted [Action Plan Ref 4, Photo 3].
Impact	1	1	1	Localised fire.	L	P5		
FLT / Vehicle Impact (Puncture)	1	1	1	Localised fire, possible injury to vehicle driver.	M	P4	Vehicle access limited.	
Short Circuit	1	1	1	Localised fire, damage to equipment.	L	P5	Equipment is used as intended and is designed to recognised standard.	Internally IP socket covers were noted to be missing at several locations [Action Plan Ref 14, Photo 12].
Earth Fault	1	1	1	Localised fire, explosion.	L	P5	Earthing strips fitted	
Lightning Strike	1	1	1	Localised fire, explosion.	M	P4	No evidence of this occurring. Surrounding buildings may offer protection to tanks.	
Static Electrical Discharge	1	1	1	Localised fire	L	P5	Earthing strips fitted.	
Sparking – Loose Contactors on Vehicles	1	1	1	Localised fire, damage to vehicles.	L	P5	Earthing strips fitted. Vehicles maintained. Vehicle access limited to delivery and maintenance vehicles.	

DEFINITIONS

Severity

H = Major impact or major injury/fatality / M = Serious impact or lost time injury / L = Minor impact or First aid case

Risk Definitions

P1 = Intolerable risk - work must not be started or continued until the risk has been reduced to an acceptable level

P2 = Substantial risk which must be improved through risk reduction methods

P3 = Moderate risk efforts should be made to reduce the risk within a defined time period

P4 = Risk is considered tolerable no additional controls required monitoring is required to ensure controls are maintained

P5 = No action required

Likelihood	L	M	H	
	P3	P2	P1	6 - 9
	P4	P3	P2	3 - 5
	P5	P4	P3	1 - 2
				Severity
MATRIX				

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage for heating of Store 4000		
System Description:	2x 3900 litre (water capacity) tanks and 4 x 4600 litre (water capacity) tanks		
Part 4:	Risk Assessment – Filling Operations	Location:	External

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequence of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2			See Table below		
Internal Combustion Engines	1	1	1	Localised fire, possible injury to driver.	L	P5	Vehicle access limited to essential vehicles only.	
Laser / Intense Radiation Sources	1	1	1	Localised fire, explosion.	L	P5	Tanks designed to specification.	Tanks appear to have been painted [Action Plan Ref 4, Photo 3].
Impact	1	1	1	Localised fire, damage to vehicle.	L	P5	Barriers erected, vehicle access limited.	
Earth Fault	1	1	1	Localised fire, explosion.	L	P5	Earthing strips fitted.	
Lightning Strike	1	1	1	Localised fire, explosion.	M	P4	No evidence of this occurring. Surrounding buildings may offer protection to tanks.	
Static Electrical Discharge	1	1	1	Localised fire.	L	P5	Earthing strips fitted.	
Sparking – Loose Contactors on Vehicles	1	1	1	Localised fire, damage to vehicles.	L	P5	Earthing strips fitted. Vehicles maintained. Vehicle access limited to delivery and maintenance vehicles.	

DEFINITIONS

Severity

H = Major impact or major injury/fatality / M = Serious impact or lost time injury / L = Minor impact or First aid case

Risk Definitions

P1 = Intolerable risk - work must not be started or continued until the risk has been reduced to an acceptable level

P2 = Substantial risk which must be improved through risk reduction methods

P3 = Moderate risk efforts should be made to reduce the risk within a defined time period

P4 = Risk is considered tolerable no additional controls required monitoring is required to ensure controls are maintained

P5 = No action required

	L	M	H	
Likelihood	P3	P2	P1	6 - 9
	P4	P3	P2	3 - 5
	P5	P4	P3	1 - 2
	Severity			
	MATRIX			

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage for heating of Store 4000		
System Description:	2x 3900 litre (water capacity) tanks and 4 x 4600 litre (water capacity) tanks		
Part 5:	Risk Assessment – Maintenance Operations	Location:	External

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequence of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2			See Table Below		
Heating Installations	1	1	1	Localised fire, damage to equipment.	M	P4	Heaters are industry standard and designed maintained as expected.	Internally LPG pipe work is sporadically identified [Action Plan Ref 10, Photo 9].
Internal Combustion Engines	1	1	1	Localised fire, damage to vehicle, possible explosion	M	P4	Vehicles are maintained. Vehicle access limited.	
Smoking / Naked Flames	1	1	1	Localised fire, explosion.	M	P4	Competent contractors utilised.	No permit to work system in place for work activities [Action Plan Ref 11]. Single CO ² Fire extinguisher provided for the area, this is not signed or immediately evident [Action Plan Ref 12, Photo 10].
Hot Work, e.g. Welding	1	1	1	Localised fire, possible explosion.	M	P4	Competent contractor used for maintenance tasks.	No permit to work system in place for work activities [Action Plan Ref 11]. Single CO ² Fire extinguisher provided for the area, this is not signed or immediately evident [Action Plan Ref 12, Photo 10].
Hot Surfaces	1	1	1	Localised fire, explosion.	L	P5	Competent contractors utilised.	No permit to work system in place for work activities [Action Plan Ref 11]. Single CO ² Fire extinguisher provided for the area, this is not signed or immediately evident [Action Plan Ref 12, Photo 10].
Laser / Intense Radiation Sources	1	1	1	Localised fire.	L	P5	Tanks are designed to specification.	Tanks appear to have been painted [Action Plan Ref 4, Photo 3].
Impact	1	1	1	Localised fire, damage to vehicle.	L	P5	Barriers erected, vehicle access limited.	
FLT / Vehicle Impact (Puncture)	1	1	1	Localised fire, possible injury to vehicle driver.	M	P4		

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequence of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2			See Table Below		
Grinding	1	1	1	Localised fire, possible explosion.	M	P4	Competent contractor used for maintenance tasks.	No permit to work system in place for work activities [Action Plan Ref 11]. Single CO ² Fire extinguisher provided for the area, this is not signed or immediately evident [Action Plan Ref 12, Photo 10].
Electrical Lighting	1	1	1	Localised fire, equipment damage.	L	P5	Competent contractors utilised.	Lights may be used during maintenance operations. Internally an emergency light bulk head was observed to be damaged [Action Plan Ref 13, Photo 11].
Short Circuit	1	1	1	Localised fire, damage to equipment.	L	P5	Equipment is used as intended and is designed to recognised standard.	Electrical sparks or Heat. Internally IP socket covers were noted to be missing at several locations [Action Plan Ref 14, Photo 12].
Electrical Arc	1	1	1	Localised fire, damage to equipment.	L	P5	Competent contractors utilised. Earthing strips fitted.	
Earth Fault	1	1	1	Localised fire, explosion.	L	P5	Earthing strips fitted.	
Lightning Strike	1	1	1	Localised fire, explosion.	M	P4	No evidence of this occurring. Surrounding buildings may offer protection to tanks.	
Static Electrical Discharge	1	1	1	Localised fire	L	P5	Earthing strips fitted.	
Sparking – Loose Contactors on Vehicles	1	1	1	Localised fire, damage to vehicles.	L	P5	Earthing strips fitted.	Vehicles maintained. Vehicle access limited to delivery and maintenance vehicles.

DEFINITIONS

Severity

H = Major impact or major injury/fatality / M = Serious impact or lost time injury / L = Minor impact or First aid case

Risk Definitions

P1 = Intolerable risk - work must not be started or continued until the risk has been reduced to an acceptable level

P2 = Substantial risk which must be improved through risk reduction methods

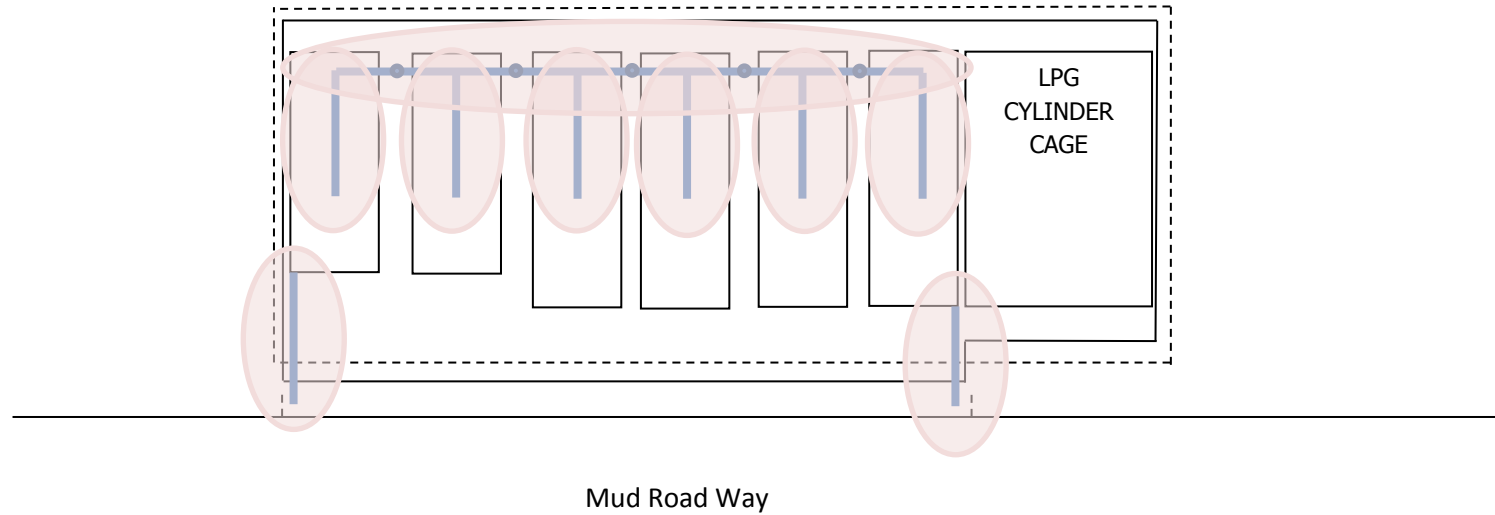
P3 = Moderate risk efforts should be made to reduce the risk within a defined time period

P4 = Risk is considered tolerable no additional controls required monitoring is required to ensure controls are maintained

P5 = No action required

	L	M	H	
Likelihood	P3	P2	P1	6 - 9
	P4	P3	P2	3 - 5
	P5	P4	P3	1 - 2
	Severity			
	MATRIX			

ZONE PLAN



0.75 metre Zone 2
around pipe work in
all directions.

(Reference IGEM SR
25)

ACTION PLAN							
Ref	Hazard	Persons at Risk	Existing Controls	Proposed Controls	Timescale	Responsibility	Date Complete
1	20 year inspections have not been undertaken [Photo 1].	Employees, contractors, visitors	Tanks are designed and manufactured to recognised specifications. Information plates clearly displayed on tanks.	Commission competent person to undertake inspection of tanks.	1 month	Chris Woodrow	
2	Valve protection covers are not secured [Photo 2].	Employees, contractors, visitors	Valve covers in situ, access to the site is controlled.	Ensure valve covers are secured.	1 month	Chris Woodrow	
3	No emergency plan is documented for the release of LPG.	Employees, contractors, visitors	Fire Marshals on site, fire risk assessment documented.	Document emergency plans ensuring location of isolation valves are marked.	6 months	Chris Woodrow	
4	Tanks appear to have been painted which may mask signs of corrosion [Photo 3].	Employees, contractors, visitors	Tanks are designed manufactured to recognised specifications.	Consult competent persons to determine risks of painting tanks and possible rectification measures.	1 month	Chris Woodrow	
5	Some connectors are showing signs of rust [Photo 4].	Employees, contractors, visitors	Pipe work appears to be designed and manufactured to recognised specifications.	Commission competent person to undertake inspection of pipe work.	1 month	Chris Woodrow	
6	LPG cage is situated within the bulk storage tank compound, to retrieve cylinders pipe work must be negotiated increasing risk of damage [Photo 5].	Employees, contractors, visitors	Training, procedures.	Relocate LPG cage to allow unhindered access to cylinder storage.	1 month	Chris Woodrow	
7	Some gauge faces are obscured by verdigris [Photo 6].	Employees, contractors, visitors	None.	Implement cleaning schedule to prevent build-up of verdigris.	1 month	Chris Woodrow	
8	Shut off valves are not signed [Photo 7].	Employees, contractors, visitors	Fire Marshals on site, training.	Sign emergency shut off valves.	1 month	Chris Woodrow	
9	Pipe work appears to have been painted which may obscure signs of corrosion [Photo 8].	Employees, contractors, visitors	Pipe work appears to be designed and manufactured to recognised specifications.	Consult competent persons to determine risks of painting tanks and possible rectification measures.	1 month	Chris Woodrow	
10	Internally LPG pipe work is sporadically identified [Photo 9].	Employees, contractors, visitors	Partial identification of LPG pipe work.	Affix LPG signage to all pipework.	3 months	Chris Woodrow	
11	No permit to work system in place for work activities.	Employees, contractors, visitors	Competent contractors utilised.	Document and implement Permit to Work system.	3 months	Chris Woodrow	
12	Single CO ₂ fire extinguisher provided for the area, this is not signed or immediately evident [Photo 10].	Employees, contractors, visitors	Firefighting equipment in situ.	Position firefighting media in an immediately identifiable and retrievable position.	3 months	Chris Woodrow	

13	Internally, an emergency light bulk head was observed to be damaged [Photo 11].	Employees, contractors	Fixed electrical testing undertaken, RCD fuse boards utilised.	Repair emergency lighting bulkhead to reduce likelihood of sparks from faults.	1 month	Chris Woodrow	
14	Internally, IP socket covers were noted to be missing at several locations [Photo 12].	Employees, contractors	Fixed electrical testing undertaken, RCD fuse boards utilised.	Repair IP sockets to reduce likelihood of sparks from faults.	1 month	Chris Woodrow	
15	Externally pipe work appears to be shielded in plastic sheathing however it was not possible to determine if this continues underground [Photo 13].	Employees, contractors, visitors	Plastic sheathing visible above ground. Written Scheme of examination documented.	Confirm if underground metallic pipework has been replaced with pipework made from non-materials such as polyethylene (plastic) which won't corrode in line with the HSE's pipework replacement programme.	1 month	Chris Woodrow	
16	Cylinder LPG cage is within separation distance of first LPG tank [Photo 14].	Employees, visitors, contractors	Tanks are designed to specification. Cylinders are designed to manufactures specification.	Ensure adequate separation distance (1 meter) from other tanks is provided as per distances stated by the by the HSE.	6 months	Chris Woodrow	



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



Photo 7



Photo 8



Photo 9



Photo 10



Photo 11

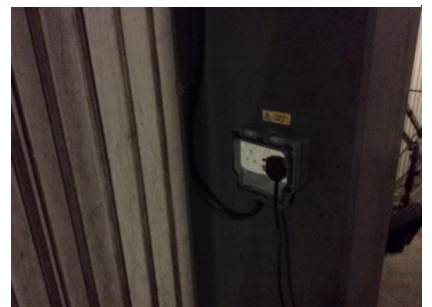


Photo 12



Photo 13



Photo 14

Appendix C

DSEAR Risk Assessment – LPG storage for heating of Store 5000

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage for heating of Store 5000		
System Description:	2x 3900 litre (water capacity) tanks and 4 x 4600 litre (water capacity) tanks		
Part 1:	Dangerous Substances & Hazardous Area Classification	Location:	Rear of Store 5000

DANGEROUS SUBSTANCES CHARACTERISTICS

Substance Name	Composition	Phase (gas / liquid)	Flammable Limits (in air)		Flash Point (°C)	Density (water = 1)	Gas Relative Density (air = 1)	Auto Ignition Temperature (°C)	Group & Temperature Class	Minimum Ignition Energy (mJ)
			LEL (%)	UEL (%)						
Propane	100%	Liquid	2.2	9.5	-104	0.56	1.56	470	IIA T1	0.25

Potential Release Source	Location	Likelihood of Release	Dangerous Substances Operating Conditions		Ventilation		Hazardous Area			Remarks
			Pressure (barg)	Temperature (°C)	Type	Degree / Availability	Zone Type (0-1-2)	Zone Extent Vert. (M)	Zone Extent Horiz. (M)	
Leaking Valve Outlet (Damaged Valve Seat)	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	Tank accessories are designed and manufactured to recognised specification. Inspections have not been undertaken [Action Plan Ref 1, Photo 1]. Valve protection covers are not secured [Action Plan Ref 2, Photo 2].
Safety Valve	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	No emergency plan is documented for the release of LPG [Action Plan Ref 3].
Relief Valve Fails to Open	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	20 year inspections are due on a number of tanks [Action Plan Ref 1]. Tanks appear to have been painted which may mask signs of corrosion [Action Plan Ref 4, Photo 3]. Tank specification plates displayed. Vegetation was observed to be growing around the tank [Action Plan Ref 12, Photo 10].
Tank Shell Corrosion	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	
Joints Failure. Leaks, Corrosion Etc.	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	Some connectors are showing signs of rust [Action Plan Ref 5, Photo 4].
Puncture (FLT)	External	0	1.4	Ambient	Natural	VL	2	0.75*	0.75*	Forklift trucks do not visit the area since the relocation of the filling points.
Pressure Accessories. Valves, Regulators, Gauges	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	Some gauge faces are obscured by verdigris [Action Plan Ref 6, Photo 5]. Shut off valves are not signed [Action Plan Ref 7, Photo 6].
Valve Packing – Bubble Leak	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	20 year inspections are due, some joints are showing signs of rust [Action Plan Ref 1].

Potential Release Source	Location	Likelihood of Release	Dangerous Substances Operating Conditions		Ventilation		Hazardous Area			Remarks
			Pressure (barg)	Temperature (°C)	Type	Degree / Availability	Zone Type (0-1-2)	Zone Extent Vert. (M)	Zone Extent Horiz. (M)	
Failure of Pipe Work	External	1	1.4	Ambient	Natural	VL	2	0.75*	0.75*	Pipe work appears to have been painted which may obscure signs of corrosion [Action Plan Ref 4]. Barriers erected to protect pipe work leading to stores. Written Scheme of examination documented. Externally pipe work appears to be shielded in plastic sheathing however it was not possible to determine if this continues underground [Action Plan Ref 13, Photo 11].

DEFINITIONS

LIKELIHOOD OF RELEASE

3 = Continuous (permanent or long periods of release to atmosphere during normal operation)
 2 = Primary (release expected during normal operation)
 1 = Secondary (release NOT expected during normal operation)
 0 = Probability considered negligible, DSEAR risk assessment not required

VENTILATION - TYPE

Natural = Open air
 or, Open building with vents in walls/roof designed with regard to relative density of gas/vapour equivalent to open-air
 or, Building that is not open but with permanent natural ventilation openings

Artificial = General or local means of air movement/air replacement within a building or open air to aid/control product dispersal

VENTILATION - DEGREE

Degree and availability influences the effectiveness of controlling dispersion and persistence of the explosive atmosphere classified as follows:

VH = High ventilation (can reduce concentration virtually instantly to below LEL, resulting in negligible zone extent, but subject to ventilation availability/reliability)
 VM = Medium ventilation (can control concentration whilst release in progress to give stable zone, and explosive atmosphere does not exist after release stopped)
 VL = Low ventilation (CANNOT control concentration whilst release in progress, and/or cannot prevent persistence of explosive atmosphere after release stopped)

ZONE TYPE

Based upon the likelihood of presence of explosive atmosphere dependent upon the grade of release and ventilation (according to EN60079-10)

0 = Where an explosive atmosphere is present continuously / for long periods / frequently (normally 'continuous' grade of release)
 1 = Where an explosive atmosphere is likely to occur in normal operation occasionally (normally 'primary' grade of release)
 2 = Where an explosive atmosphere is NOT likely to occur in normal operation, but if it does, will persist for a short period only (normally 'secondary' grade of release)

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage for heating of Store 5000		
System Description:	2x 3900 litre (water capacity) tanks and 4 x 4600 litre (water capacity) tanks		
Part 2:	Ignition Sources & Personnel Exposure	Location:	External

Ignition Sources Category	Ignition Source	Likelihood of Ignition Sources Occurring			Remarks
		Normal Operation	Filling Operations	Maintenance Operations	
Heat Energy					
	Heating Installations	1	0	1	LPG storage tanks provide fuel for heating systems stored internally.
	Internal Combustion Engines	0	1	1	Filling operation undertaken by an external contractor which arrives in a vehicle
	Smoking / Naked Flames	0	0	1	
	Hot Work (e.g. Welding)	0	0	1	
	Hot Surfaces	0	0	1	
	Laser / Intense Radiation Sources	1	1	1	Tanks / pipes are external and appear to have been painted [Action Plan Ref 4, Photo 3].
Mechanical Energy					
	Friction / Overheating	0	0	0	
	Ultrasonic	0	0	0	
	Impact	1	1	1	Vehicles are seldom in the vicinity however contractors and employees may require to use vehicles.
	FLT / Vehicle Impact (Puncture)	1	0	1	Vehicles are seldom in the vicinity however employees may require to use vehicles in the area.
	Grinding	0	0	1	Grinding may occur during maintenance activities.
	Compression	0	0	0	
Chemical Energy					
	Self-Heating	0	0	0	
	Impact / Heat Sensitive Materials	0	0	0	
	Runaway / Exothermic Reaction	0	0	0	
Electrical Energy					
	Electrical Lighting	0	0	1	Lights may be used during maintenance operations.
	Electromagnetic Radiation	0	0	0	
	Short Circuit	1	0	1	
	Electrical Arc	0	0	1	
	Earth Fault	1	1	1	Earthing strip on the first tank has become dislodged from its connector [Action Plan Ref 8, Photo 7].
	Conductor Fault	0	0	0	
	Lighting Strike	1	1	1	
	Static Electrical Discharge	1	1	1	
	Sparking – Loose Contactors on Vehicles	1	1	1	Vehicles are maintained.
	Excessive Temperature Rise Due to Overload of Equipment	0	0	0	
	Induction Heating	0	0	0	
	Resistive Heating	0	0	0	

DEFINITIONS

LIKELIHOOD OF IGNITION SOURCE OCCURRING

- 3** = Present continuously or for long periods (>1000 hours / year)
2 = Likely to occur (>10 < 1000 hour / year)
1 = Not likely to occur or infrequent and for short periods (<10 hours / year)
0 = Not present

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage for heating of Store 5000		
System Description:	2x 3900 litre (water capacity) tanks and 4 x 4600 litre (water capacity) tanks		
Part 3:	Risk Assessment – Normal Operations	Location:	External

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequences of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2					
Heating Installations	1	1	1	Localised fire, damage to equipment, possible injury to employee.	L	P5		Heating installations are internally stored product dryers. These are not in close proximity to the LPG bulk tanks.
Laser / Intense Radiation Sources	1	1	1		L	P5	Tanks are designed and manufactured to recognised specification.	Tanks appear to have been painted [Action Plan Ref 4, Photo 3].
Impact	1	1	1	Localised fire.	L	P5		
FLT / Vehicle Impact (Puncture)	1	1	1	Localised fire, possible injury to vehicle driver.	M	P4	Vehicle access limited.	
Short Circuit	1	1	1	Localised fire, damage to equipment.	L	P5	Equipment is used as intended and is designed to recognised standard.	Electrical distribution boards observed to have blanking plates missing and have been left open [Action Plan Ref 11, Photo 9].
Earth Fault	1	1	1	Fire, explosion.	L	P5	Earthing strips fitted.	
Lighting Strike	1	1	1	Major localised damage.	M	P4	No evidence of this occurring, adjacent buildings may offer some protection.	
Static Electrical Discharge	1	1	1	Localise fire.	L	P5	Earthing strip on the first tank has become dislodged from its connector [Action Plan Ref 8, Photo 7].	
Sparking – Loose Contactors on Vehicles	1	1	1	Localised fire, damage to vehicle.	L	P5		Vehicles maintained. Vehicle access limited to delivery and maintenance vehicles.

DEFINITIONS

Severity

H = Major impact or major injury/fatality / M = Serious impact or lost time injury / L = Minor impact or First aid case

Risk Definitions

P1 = Intolerable risk - work must not be started or continued until the risk has been reduced to an acceptable level

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P3 = Moderate risk efforts should be made to reduce the risk within a defined time period

P4 = Risk is considered tolerable no additional controls required monitoring is required to ensure controls are maintained

P5 = No action required

Likelihood	L	M	H	
	P3	P2	P1	6 - 9
	P4	P3	P2	3 - 5
	P5	P4	P3	1 - 2
Severity				
MATRIX				

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage for heating of Store 5000		
System Description:	2x 3900 litre (water capacity) tanks and 4 x 4600 litre (water capacity) tanks		
Part 4:	Risk Assessment – Filling Operations	Location:	External

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequence of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2			See Table below		
Internal Combustion Engines	1	1	1	Localised fire, possible injury to driver.	L	P5	Vehicle access limited to essential vehicles only.	
Laser / Intense Radiation Sources	1	1	1	Localised fire, explosion.	M	P4	Tanks designed to specification.	Tanks appear to have been painted [Action Plan Ref 4, Photo 3].
Impact	1	1	1	Localised fire, damage to vehicle.	L	P5	Barriers erected, vehicle access limited.	
Earth Fault	1	1	1	Localised fire, explosion.	L	P5	Earthing strips fitted.	Earthing strip on the first tank has become dislodged from its connector [Action Plan Ref 8, Photo 7].
Lightning Strike	1	1	1	Localised fire, explosion.	M	P4	Earthing strips fitted, surrounding buildings may offer some protection.	Earthing strip on the first tank has become dislodged from its connector [Action Plan Ref 8, Photo 7].
Static Electrical Discharge	1	1	1	Localised fire.	L	P5	Earthing strips fitted.	Earthing strip on the first tank has become dislodged from its connector [Action Plan Ref 8, Photo 7].
Sparking – Loose Contactors on Vehicles	1	1	1	Localised fire, damage to vehicles.	L	P5	Earthing strips fitted.	Vehicles maintained. Vehicle access limited to delivery and maintenance vehicles.

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Severity

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Risk Definitions

P1 = Intolerable risk - work must not be started or continued until the risk has been reduced to an acceptable level

P2 = Substantial risk which must be improved through risk reduction methods

P3 = Moderate risk efforts should be made to reduce the risk within a defined time period

P4 = Risk is considered tolerable no additional controls required monitoring is required to ensure controls are maintained

P5 = No action required

	L	M	H	
Likelihood	P3	P2	P1	6 - 9
	P4	P3	P2	3 - 5
	P5	P4	P3	1 - 2
	Severity			
	MATRIX			

Customer:	Moulton Bulb Company Limited	Address:	Long Lane, Moulton, Spalding, PE12 6PP
Pressure System:	LPG storage for heating of Store 5000		
System Description:	2x 3900 litre (water capacity) tanks and 4 x 4600 litre (water capacity) tanks		
Part 5:	Risk Assessment – Maintenance Operations	Location:	External

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequence of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2			See Table below		
Heating Installations	1	1	1	Localised fire, damage to equipment.	M	P4	Heaters are industry standard and designed maintained as expected.	Internally LPG pipe work is sporadically identified [Action Plan Ref 10, Photo 8].
Internal Combustion Engines	1	1	1	Localised fire, damage to vehicle, possible explosion.	M	P4	Vehicles are maintained. Vehicle access limited.	
Smoking / Naked Flames	1	1	1	Localised fire, explosion.	M	P4	Competent contractors utilised.	No permit to work system in place for work activities [Action Plan Ref 9].
Hot Work, e.g. Welding	1	1	1	Localised fire, possible explosion.	M	P4	Competent contractor used for maintenance tasks.	No permit to work system in place for work activities [Action Plan Ref 9].
Hot Surfaces	1	1	1	Localised fire, explosion.	L	P5	Competent contractors utilised.	No permit to work system in place for work activities [Action Plan Ref 9].
Laser / Intense Radiation Sources	1	1	1	Localised fire.	M	P4	Tanks are designed to specification.	Tanks appear to have been painted [Action Plan Ref 4, Photo 3].
Impact	1	1	1	Localised fire, damage to vehicle.	L	P5	Barriers erected, vehicle access limited.	
FLT / Vehicle Impact (Puncture)	1	1	1	Localised fire, possible injury to vehicle driver.	M	P4		
Grinding	1	1	1	Localised fire, possible explosion	M	P4	Competent contractor used for maintenance tasks.	No permit to work system in place for work activities [Action Plan Ref 9].
Electrical Lighting	1	1	1	Localised fire, equipment damage	L	P5	Competent contractors utilised.	Lights may be used during maintenance operations.
Short Circuit	1	1	1	Localised fire, damage to equipment	L	P5	Equipment is used as intended and is designed to recognised standard.	Electrical sparks or Heat.
Electrical Arc	1	1	1	Localised fire, damage to equipment	L	P5	Competent contractors utilised. Earthing strips fitted.	

Identified Risk & Location	Likelihood of Release	Likelihood of Ignition Source Occurring	Likelihood of Explosion or Fire	Consequence of Ignition	Severity (L,M,H)	Assessed Level of Risk	Existing Control Measures	Remarks / Additional Requirements
	From Part 1	From Part 2	Part 1 x Part 2			See Table below		
Earth Fault	1	1	1	Localised fire, explosion	L	P5	Earthing strips fitted.	Earthing strip on the first tank has become dislodged from its connector [Action Plan Ref 8, Photo 7].
Lightning Strike	1	1	1	Localised fire, explosion	M	P4	Earthing strips fitted, surrounding buildings may offer some protection.	Earthing strip on the first tank has become dislodged from its connector [Action Plan Ref 8, Photo 7].
Static Electrical Discharge	1	1	1	Localised fire	L	P5	Earthing strips fitted.	Earthing strip on the first tank has become dislodged from its connector [Action Plan Ref 8, Photo 7].
Sparking – Loose Contactors on Vehicles	1	1	1	Localised fire, damage to vehicles	L	P5	Earthing strips fitted.	Earthing strip on the first tank has become dislodged from its connector [Action Plan Ref 8, Photo 7]. Vehicles maintained. Vehicle access limited to delivery and maintenance vehicles.

DEFINITIONS

Severity

H = Major impact or major injury/fatality / M = Serious impact or lost time injury / L = Minor impact or First aid case

Risk Definitions

P1 = Intolerable risk - work must not be started or continued until the risk has been reduced to an acceptable level

P2 = Substantial risk which must be improved through risk reduction methods

P3 = Moderate risk efforts should be made to reduce the risk within a defined time period

P4 = Risk is considered tolerable no additional controls required monitoring is required to ensure controls are maintained

P5 = No action required

	L	M	H	
Likelihood	P3	P2	P1	6 - 9
	P4	P3	P2	3 - 5
	P5	P4	P3	1 - 2
	Severity			
	MATRIX			

ZONE PLAN



Mud Road Way

0.75 meter Zone 2
around pipe work in
all directions

(Reference IGEM SR
25)

ACTION PLAN							
Ref	Hazard	Persons at Risk	Existing Controls	Proposed Controls	Timescale	Responsibility	Date Complete
1	20 year inspections have not been undertaken [Photo 1].	Employees, contractors, visitors	Tank accessories are designed and manufactured to recognised specification.	Commission a competent person to undertake testing.	1 month	Chris Woodrow	
2	Valve protection covers are not secured [Photo 2].	Employees, contractors, visitors	Valve covers are in situ.	Secure valve protection covers to reduce risk of adverse weather damage and unauthorised tampering.	1 month	Chris Woodrow	
3	No emergency plan is documented for the release of LPG.	Employees, contractors, visitors	Fire Marshals on site.	Document emergency plan.	6 months	Chris Woodrow	
4	Tanks appear to have been painted which may mask signs of corrosion [Photo 3].	Employees, contractors, visitors	Tank accessories are designed and manufactured to recognised specification.	Consult competent person as to the impact of painting tanks.	1 month	Chris Woodrow	
5	Some connectors are showing signs of rust [Photo 4].	Employees, contractors, visitors	Pipes and accessories are designed and manufactured to recognised specification.	Consult competent person as to the extent of corrosion and steps to minimise.	1 month	Chris Woodrow	
6	Some gauge faces are obscured by verdigris [Photo 5].	Employees, contractors, visitors	Pipes and accessories are designed and manufactured to recognised specification.	Consult competent person as to the extent of corrosion and steps to minimise.	1 month	Chris Woodrow	
7	Shut off valves are not signed [Photo 6].	Employees, contractors, visitors	Fire Marshals are aware of location of isolation valves.	Sign isolation valves.	1 month	Chris Woodrow	
8	Earthing strip on the first tank has become dislodged from its connector [Photo 7].	Employees, contractors, visitors	Majority of tanks have earthing strips fitted.	Reattach earthing strip.	1 month	Chris Woodrow	
9	No permit to work system in place for work activities.	Employees, contractors, visitors	Competent contractors used.	Document permit to work.	3 months	Chris Woodrow	
10	Internally LPG pipe work is sporadically identified [Photo 8].	Employees, contractors, visitors	LPG pipe sporadically marked.	Mark LPG pipe to allow prompt identification.	3 months	Chris Woodrow	
11	Electrical distribution boards observed to have blanking plates missing and have been left open [Photo 9].	Employees, contractors, visitors	Fixed electrical testing undertaken.	Replace blanking boards. Close distribution boards when not in use.	1 month	Chris Woodrow	
12	Vegetation was observed to be growing around the tank [Photo 10].	Employees, contractors, visitors	Vegetation is currently cut short.	Keep weeds and grass cut down around the tank.	6 months	Chris Woodrow	

ACTION PLAN							
Ref	Hazard	Persons at Risk	Existing Controls	Proposed Controls	Timescale	Responsibility	Date Complete
13	Externally pipe work appears to be shielded in plastic sheathing however it was not possible to determine if this continues underground [Photo 11].	Employees, contractors, visitors	Plastic sheathing visible above ground. Written Scheme of examination documented.	Confirm if underground metallic pipework has been replaced with pipework made from non-materials such as polyethylene (plastic) which won't corrode in line with the HSE's pipework replacement programme.	1 month	Chris Woodrow	



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



Photo 7



Photo 8



Photo 9



Photo 10



Photo 11

Appendix D

Material Safety Data Sheet

Propane

SAFETY DATA SHEET

Propane

Issue Date: 16.01.2013
Last revised date: 08.09.2015

Version: 1. 0

SDS No.: 000010021747
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SECTION 1: Identification of the substance / mixture and of the company / undertaking

1.1 Product identifier

Product name: Propane

Trade name: Propane Instrument Grade N2.5, Propane Pure Grade N2.0, Propane Research Grade N3.5, Propane Tech Grade N1.5, Care 40

Additional identification

Chemical name: propane

Chemical formula: C₃H₈

INDEX No. 601-003-00-5

CAS-No. 74-98-6

EC No. 200-827-9

REACH Registration No. 01-2119486944-21

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses: Industrial and professional. Perform risk assessment prior to use.
Aerosol propellant. Refrigerant. Transfilling gas or liquid, Use as a fuel. Using gas alone or in mixtures for the calibration of analysis equipment. Formulation of mixtures with gas in pressure receptacles.
Consumer use.

Uses advised against Aerosol propellant. Use as a fuel.
Uses other than those listed above are not supported.

1.3 Details of the supplier of the safety data sheet

Supplier

BOC
Priestley Road, Worsley
M28 2UT Manchester

Telephone: 0800 111 333

E-mail: ReachSDS@boc.com

1.4 Emergency telephone number: 0800 111 333

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SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Directive 67/548/EEC or 1999/45/EC as amended.

F+; R12

The full text for all R-phrases is displayed in section 16.

Classification according to Regulation (EC) No 1272/2008 as amended.

Physical Hazards

Flammable gas	Category 1	H220: Extremely flammable gas.
Gases under pressure	Liquefied gas	H280: Contains gas under pressure; may explode if heated.

2.2 Label Elements



Signal Words: Danger

Hazard Statement(s): H220: Extremely flammable gas.
H280: Contains gas under pressure; may explode if heated.

Precautionary Statement

Prevention:	P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
Response:	P377: Leaking gas fire: Do not extinguish, unless leak can be stopped safely. P381: Eliminate all ignition sources if safe to do so.
Storage:	P403: Store in a well-ventilated place.
Disposal:	None.

2.3 Other hazards: Contact with evaporating liquid may cause frostbite or freezing of skin.

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SECTION 3: Composition / information on ingredients

3.1 Substances

Chemical name	propane
INDEX No.:	601-003-00-5
CAS-No.:	74-98-6
EC No.:	200-827-9
REACH Registration No.:	01-2119486944-21
Purity:	100%
	The purity of the substance in this section is used for classification only, and does not represent the actual purity of the substance as supplied, for which other documentation should be consulted.
Trade name:	Propane Instrument Grade N2.5, Propane Pure Grade N2.0, Propane Research Grade N3.5, Propane Tech Grade N1.5, Care 40

SECTION 4: First Aid Measures

General: In high concentrations may cause asphyxiation. Symptoms may include loss of mobility / consciousness. Victim may not be aware of asphyxiation. Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.

4.1 Description of first aid measures

Inhalation: In high concentrations may cause asphyxiation. Symptoms may include loss of mobility / consciousness. Victim may not be aware of asphyxiation. Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.

Eye contact: Rinse the eye with water immediately. Remove contact lenses, if present and easy to do. Continue rinsing. Flush thoroughly with water for at least 15 minutes. Get immediate medical assistance. If medical assistance is not immediately available, flush an additional 15 minutes.

Skin Contact: Contact with evaporating liquid may cause frostbite or freezing of skin.

Ingestion: Ingestion is not considered a potential route of exposure.

4.2 Most important symptoms and effects, both acute and delayed: Respiratory arrest. Contact with liquefied gas can cause damage (frostbite) due to rapid evaporative cooling. Loss of co-ordination. In low concentrations may cause narcotic effects. Dizziness. Headache. Unconsciousness. Nausea, vomiting.

4.3 Indication of any immediate medical attention and special treatment needed

Hazards: Respiratory arrest. Contact with liquefied gas can cause damage (frostbite) due to rapid evaporative cooling.

Treatment: Thaw frosted parts with lukewarm water. Do not rub affected area. Get immediate medical advice / attention.

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SECTION 5: Firefighting Measures

General Fire Hazards: Heat may cause the containers to explode.

5.1 Extinguishing media

Suitable extinguishing media: Water Spray or Fog. Dry powder. Foam.

Unsuitable extinguishing media: Carbon dioxide.

5.2 Special hazards arising from the substance or mixture: May explode in a fire.

Hazardous Combustion Products: Incomplete combustion may form carbon monoxide

5.3 Advice for firefighters

Special fire fighting procedures: In case of fire: Stop leak if safe to do so. Do not extinguish flames at leak because possibility of uncontrolled explosive re-ignition exists. Continue water spray from protected position until container stays cool. Use extinguishants to contain the fire. Isolate the source of the fire or let it burn out.

Special protective equipment for firefighters: Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA. Guideline: EN 469 Protective clothing for firefighters. Performance requirements for protective clothing for firefighting. EN 15090 Footwear for firefighters. EN 659 Protective gloves for firefighters. EN 443 Helmets for fire fighting in buildings and other structures. EN 137 Respiratory protective devices - Self-contained open-circuit compressed air breathing apparatus with full face mask - Requirements, testing, marking.

SECTION 6: Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures: Evacuate area. Provide adequate ventilation. Consider the risk of potentially explosive atmospheres. Eliminate all ignition sources if safe to do so. Monitor the concentration of the released product. Prevent from entering sewers, basements and workpits, or any place where its accumulation can be dangerous. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe. EN 137 Respiratory protective devices - Self-contained open-circuit compressed air breathing apparatus with full face mask - Requirements, testing, marking.

6.2 Environmental Precautions: Prevent further leakage or spillage if safe to do so.

6.3 Methods and material for containment and cleaning up: Provide adequate ventilation. Eliminate sources of ignition.

6.4 Reference to other sections: Refer to sections 8 and 13.

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SECTION 7: Handling and Storage:**7.1 Precautions for safe handling:**

Only experienced and properly instructed persons should handle gases under pressure. Use only properly specified equipment which is suitable for this product, its supply pressure and temperature. Purge system with dry inert gas (e.g. helium or nitrogen) before gas is introduced and when system is placed out of service. Purge air from system before introducing gas. Containers, which contain or have contained flammable or explosive substances, must not be inerted with liquid carbon dioxide. Assess the risk of a potentially explosive atmosphere and the need for suitable equipment i.e. explosion-proof. Take precautionary measures against static discharges. Keep away from ignition sources (including static discharges). Provide electrical earthing of equipment and electrical equipment usable in explosive atmospheres. Use only non-sparking tools. Refer to supplier's handling instructions. The substance must be handled in accordance with good industrial hygiene and safety procedures. Ensure the complete system has been (or is regularly) checked for leaks before use. Protect containers from physical damage; do not drag, roll, slide or drop. Do not remove or deface labels provided by the supplier for the identification of the container contents. When moving containers, even for short distances, use appropriate equipment eg. trolley, hand truck, fork truck etc. Secure cylinders in an upright position at all times, close all valves when not in use. Provide adequate ventilation. Suck back of water into the container must be prevented. Do not allow backfeed into the container. Avoid suckback of water, acid and alkalis. Observe all regulations and local requirements regarding storage of containers. When using do not eat, drink or smoke. Store in accordance with local / regional / national / international regulations. Never use direct flame or electrical heating devices to raise the pressure of a container. Leave valve protection caps in place until the container has been secured against either a wall or bench or placed in a container stand and is ready for use. Damaged valves should be reported immediately to the supplier. Close container valve after each use and when empty, even if still connected to equipment. Never attempt to repair or modify container valves or safety relief devices. Replace valve outlet caps or plugs and container caps where supplied as soon as container is disconnected from equipment. Keep container valve outlets clean and free from contaminants particularly oil and water. If user experiences any difficulty operating container valve discontinue use and contact supplier. Never attempt to transfer gases from one container to another. Container valve guards or caps should be in place.

7.2 Conditions for safe storage, including any incompatibilities:

All electrical equipment in the storage areas should be compatible with the risk of a potentially explosive atmosphere. Segregate from oxidant gases and other oxidants being stored. Containers should not be stored in conditions likely to encourage corrosion. Stored containers should be periodically checked for general conditions and leakage. Container valve guards or caps should be in place. Store containers in location free from fire risk and away from sources of heat and ignition. Keep away from combustible material. Keep container below 50°C in a well ventilated place.

7.3 Specific end use(s):

None.

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SECTION 8: Exposure Controls / Personal Protection

8.1 Control Parameters

Occupational Exposure Limits

None of the components have assigned exposure limits.

8.2 Exposure controls

Appropriate engineering controls:

Consider a work permit system e.g. for maintenance activities. Ensure adequate air ventilation. Provide adequate general and local exhaust ventilation. Keep concentrations well below lower explosion limits. Gas detectors should be used when quantities of flammable gases or vapours may be released. Systems under pressure should be regularly checked for leakages. Product to be handled in a closed system. Use only permanent leak tight installations (e.g. welded pipes). Take precautionary measures against static discharges. Gas detectors should be used when toxic quantities may be released.

Individual protection measures, such as personal protective equipment

General information:

A risk assessment should be conducted and documented in each work area to assess the risks related to the use of the product and to select the PPE that matches the relevant risk. The following recommendations should be considered. Keep self contained breathing apparatus readily available for emergency use. Personal protective equipment for the body should be selected based on the task being performed and the risks involved. Refer to local regulations for restriction of emissions to the atmosphere. See section 13 for specific methods for waste gas treatment. Do not eat, drink or smoke when using the product.

Eye / face protection:

Safety eyewear, goggles or face-shield to EN166 should be used to avoid exposure to liquid splashes. Wear eye protection to EN 166 when using gases. Guideline: EN 166 Personal Eye Protection.

Skin protection

Hand Protection:

Wear working gloves while handling containers
Guideline: EN 388 Protective gloves against mechanical risks.

Body protection:

Wear fire / flame resistant / retardant clothing.
Guideline: EN 943 Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles.

Other:

Wear safety shoes while handling containers
Guideline: ISO 20345 Personal protective equipment - Safety footwear.

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Respiratory Protection: Respiratory protection may be required. When allowed by a risk assessment Respiratory Protective Equipment (RPE) may be used The selection of the Respiratory Protective Device (RPD) must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected RPD.
Material: Filter AX
Guideline: EN 14387 Respiratory protective devices. Gas filter(s) and combined filter(s). Requirements, testing, marking.
Guideline: EN 136 Respiratory protective devices. Full face masks. Requirements, testing, marking.

Thermal hazards: No precautionary measures are necessary.

Hygiene measures: Specific risk management measures are not required beyond good industrial hygiene and safety procedures. Do not eat, drink or smoke when using the product.

Environmental exposure controls: For waste disposal, see section 13.

SECTION 9: Physical And Chemical Properties

9.1 Information on basic physical and chemical properties

Appearance

Physical state:	Gas
Form:	Liquefied gas
Colour:	Colourless
Odour:	Odourless
Odour Threshold:	Odour threshold is subjective and is inadequate to warn of over exposure.
pH:	not applicable.
Melting Point:	-187.6 °C
Boiling Point:	-42.1 °C (101.325 kPa)
Sublimation Point:	not applicable.
Critical Temp. (°C):	96.7 °C
Flash Point:	Not applicable to gases and gas mixtures.
Evaporation Rate:	Not applicable to gases and gas mixtures.
Flammability (solid, gas):	Flammable Gas
Flammability limit - upper (%):	12.5 %(V)
Flammability limit - lower(%):	1.7 %(V)
Vapour pressure:	953.25 kPa (25 °C)
Vapour density (air=1):	1.56 (0 °C) AIR=1
Relative density:	0.5853 (-45 °C) 4 °C
Solubility(ies)	
Solubility in Water:	75 mg / l
Partition coefficient (n-octanol / water):	2.36
Autoignition Temperature:	472 °C

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Decomposition Temperature: 650 °C Decomp to ethylene and ethane.

Viscosity

Kinematic viscosity: No data available.

Dynamic viscosity: 0.08 mPa.s (17.9 °C)

Explosive properties: Not applicable.

Oxidising Properties: not applicable.

9.2 Other information: Gas /vapour heavier than air. May accumulate in confined spaces, particularly at or below ground level.

Molecular weight: 44.09 g / mol (C₃H₈)

Minimum ignition energy: 0.25 mJ

SECTION 10: Stability and Reactivity

10.1 Reactivity: No reactivity hazard other than the effects described in sub-section below.

10.2 Chemical Stability: Stable under normal conditions.

10.3 Possibility of Hazardous Reactions: Can form a potentially explosive atmosphere in air. May react violently with oxidants.

10.4 Conditions to Avoid: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

10.5 Incompatible Materials: Air and oxidisers. For material compatibility see latest version of ISO-11114.

10.6 Hazardous Decomposition Products: Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological Information

General information: None.

11.1 Information on toxicological effects

Acute toxicity - Oral Product Based on available data, the classification criteria are not met.

Acute toxicity - Dermal Product Based on available data, the classification criteria are not met.

Acute toxicity - Inhalation Product

Skin Corrosion / Irritation Product Based on available data, the classification criteria are not met.

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Serious Eye Damage / Eye Irritation

Product Based on available data, the classification criteria are not met.

Respiratory or Skin Sensitisation

Product Based on available data, the classification criteria are not met.

Germ Cell Mutagenicity

Product Based on available data, the classification criteria are not met.

Carcinogenicity

Product Based on available data, the classification criteria are not met.

Reproductive toxicity

Product Based on available data, the classification criteria are not met.

Specific Target Organ Toxicity - Single Exposure

Product Based on available data, the classification criteria are not met.

Specific Target Organ Toxicity - Repeated Exposure

Product Based on available data, the classification criteria are not met.

Aspiration Hazard

Product Not applicable to gases and gas mixtures..

SECTION 12: Ecological Information

12.1 Toxicity

Acute toxicity

Product No ecological damage caused by this product.

Acute toxicity - Fish

propane LC50 (Fish, 96 h): 49.9 mg / l

Acute toxicity - Aquatic Invertebrates

propane EC50 (Water flea (Daphnia magna), 48 h): 27.1 mg / l

Toxicity to microorganisms

propane EC50 (Alga, 72 h): 11.9 mg / l

12.2 Persistence and Degradability

Product Not applicable to gases and gas mixtures..

12.3 Bioaccumulative Potential

Product The product is expected to biodegrade and is not expected to persist for long periods in an aquatic environment.

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12.4 Mobility in Soil

Product

Because of its high volatility, the product is unlikely to cause ground or water pollution.

12.5 Results of PBT and vPvB assessment

Product

Not classified as PBT or vPvB.

12.6 Other Adverse Effects:

Global Warming Potential

Global warming potential: 3
Contains greenhouse gas(es). When discharged in large quantities may contribute to the greenhouse effect.
Global warming potential: 3
Contains greenhouse gas(es) not covered by 842 / 2006 / EC. Contains greenhouse gas(es). When discharged in large quantities may contribute to the greenhouse effect.

propane

Global warming potential: 3

Global warming potential: 3

SECTION 13: Disposal Considerations

13.1 Waste treatment methods

General information:

Do not discharge into any place where its accumulation could be dangerous. Consult supplier for specific recommendations. Do not discharge into areas where there is a risk of forming an explosive mixture with air. Waste gas should be flared through a suitable burner with flash back arrestor.

Disposal methods:

Refer to the EIGA code of practice (Doc.30 "Disposal of Gases", downloadable at <http://www.eiga.org>) for more guidance on suitable disposal methods. Dispose of container via supplier only. Discharge, treatment, or disposal may be subject to national, state, or local laws.

European Waste Codes

Container:

16 05 04*: gases in pressure containers (including halons) containing dangerous substances

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SECTION 14: Transport Information

ADR

14.1 UN Number:	UN 1978
14.2 UN Proper Shipping Name:	PROPANE
14.3 Transport Hazard Class(es)	
Class:	2
Label(s):	2.1
Hazard No. (ADR):	23
Tunnel restriction code:	(B/D)
Emergency Action Code:	2YE
14.4 Packing Group:	–
14.5 Environmental hazards:	not applicable
14.6 Special precautions for user:	–

RID

14.1 UN Number:	UN 1978
14.2 UN Proper Shipping Name	PROPANE
14.3 Transport Hazard Class(es)	
Class:	2
Label(s):	2.1
14.4 Packing Group:	–
14.5 Environmental hazards:	not applicable
14.6 Special precautions for user:	–

IMDG

14.1 UN Number:	UN 1978
14.2 UN Proper Shipping Name:	PROPANE
14.3 Transport Hazard Class(es)	
Class:	2.1
Label(s):	2.1
EmS No.:	F-D, S-U
14.3 Packing Group:	–
14.5 Environmental hazards:	not applicable
14.6 Special precautions for user:	–

IATA

14.1 UN Number:	UN 1978
14.2 Proper Shipping Name:	Propane
14.3 Transport Hazard Class(es):	
Class:	2.1
Label(s):	2.1
14.4 Packing Group:	–
14.5 Environmental hazards:	not applicable
14.6 Special precautions for user:	–
Other information	
Passenger and cargo aircraft:	Forbidden.
Cargo aircraft only:	Allowed.

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: not applicable

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Additional identification:

Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers ensure that they are firmly secured. Ensure that the container valve is closed and not leaking. Container valve guards or caps should be in place. Ensure adequate air ventilation.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations / legislation specific for the substance or mixture:

EU Regulations

Regulation (EC) No. 1907 / 2006 Annex XVII Substances subject to restriction on marketing and use:

Chemical name	CAS-No.	Concentration
propane	74-98-6	

Directive 2004 / 37 / EC on the protection of workers from the risks related to exposure to carcinogens and mutagens at work.:

Chemical name	CAS-No.	Concentration
propane	74-98-6	100%

Directive 92 / 85 / EEC: on the safety and health of pregnant workers and workers who have recently given birth or are breast feeding.:

Chemical name	CAS-No.	Concentration
propane	74-98-6	100%

Directive 96 / 82 / EC (Seveso II): on the control of major accident hazards involving dangerous substances:

Chemical name	CAS-No.	Concentration
propane	74-98-6	100%

Directive 98 / 24 / EC on the protection of workers from the risks related to chemical agents at work:

Chemical name	CAS-No.	Concentration
propane	74-98-6	100%

National Regulations

Dangerous Substances and Explosive Atmospheres Regulations (DSEAR 2002 No. 2776). Management of Health and Safety at Work Regulations (1999 No. 3242). The Regulatory Reform (Fire Safety) Order 2005 (2005 No. 1541). Control of Substances Hazardous to Health Regulations (COSHH, 2002 No. 2677). Provision and Use of Work

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Equipment Regulations (PUWER, 1998 No. 2306). Personal Protective Equipment Regulations (1992 No. 2966). Control of Major Accident Hazards Regulations (COMAH, 2015 No. 483). Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations (EPS, 1996 No. 192). Pressure Systems Safety Regulations (PSSR, 2000 No. 128). Only products that comply with the food regulations (EC) No. 1333 / 2008 and (EU) No. 231 / 2012 and are labelled as such may be used as food additives.
This Safety Data Sheet has been produced to comply with Regulation (EU) 453 / 2010.

15.2 Chemical safety assessment: CSA has been carried out.

SECTION 16: Other Information

Revision Information: Not relevant.

Key literature references and sources for data: Various sources of data have been used in the compilation of this SDS, they include but are not exclusive to:
 Agency for Toxic Substances and Diseases Registry (ATSDR) (<http://www.atsdr.cdc.gov/>).
 European Chemical Agency: Guidance on the Compilation of Safety Data Sheets.
 European Chemical Agency: Information on Registered Substances <http://apps.echa.europa.eu/registered/registered-sub.aspx#search>
 European Industrial Gases Association (EIGA) Doc. 169 Classification and Labelling guide.
 International Programme on Chemical Safety (<http://www.inchem.org/>)
 ISO 10156:2010 Gases and gas mixtures - Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets.
 Matheson Gas Data Book, 7th Edition.
 National Institute for Standards and Technology (NIST) Standard Reference Database Number 69.
 The ESIS (European chemical Substances 5 Information System) platform of the former European Chemicals Bureau (ECB) ESIS (<http://ecb.jrc.ec.europa.eu/esis/>).
 The European Chemical Industry Council (CEFIC) ERICards.
 United States of America's National Library of Medicine's toxicology data network TOXNET (<http://toxnet.nlm.nih.gov/index.html>)
 Threshold Limit Values (TLV) from the American Conference of Governmental Industrial Hygienists (ACGIH).
 Substance specific information from suppliers.
 Details given in this document are believed to be correct at the time of publication.
 EH40 (as amended) Workplace exposure limits.

Wording of the R-phrases and H-statements in sections 2 and 3

H220	Extremely flammable gas.
H280	Contains gas under pressure; may explode if heated.
R12	Extremely flammable.

Training information: Users of breathing apparatus must be trained. Ensure operators understand the flammability hazard.

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Classification according to Regulation (EC) No 1272 / 2008 as amended.

Flam. Gas 1, H220
Press. Gas Liq. Gas, H280

Other information:

Before using this product in any new process or experiment, a thorough material compatibility and safety study should be carried out. Ensure adequate air ventilation. Ensure all national / local regulations are observed. Ensure equipment is adequately earthed. Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use can be accepted. Note: When the Product Name appears in the SDS header the decimal sign and its position comply with rules for the structure and drafting of international standards, and is a comma on the line. As an example 2,000 is two (to three decimal places) and not two thousand, whilst 1.000 is one thousand and not one (to three decimal places).

Last revised date:

08.09.2015

Disclaimer:

This information is provided without warranty. The information is believed to be correct. This information should be used to make an independent determination of the methods to safeguard workers and the environment.

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