Appendix 4. Multiple Direct Fired Vaporiser Installations

EXECUTIVE SUMMARY

1. New Zealand HSNO legislation requires aggregating the capacity of vaporisers and separating them from the storage tank and areas of high and low intensity land use as the aggregate quantity.

2. The previous LPG legislation of New Zealand did not have the aggregating requirement.

3. The LPG legislation of Australia, United Kingdom and United States do not have this requirement.

4. Each individual vaporiser is a separate isolatable unit with a fully self contained safety system. An event involving one vaporiser would be controlled by the safety system and the separation distances between vaporisers, the supply tank and surrounding structures and properties.

5. Whether there is a single vaporiser or multiples, they will all be fed from the same LPG tank supply. So the ultimate potential for energy release is the same and the emergency shutdown system on the tank if operated will cease all supply regardless of the number of vaporisers

INTRODUCTION

Clause 20 (3), Schedule 10 of Gazette Notice 35 (as amended) requires direct fired vaporisers to comply with the requirements set out in clause 55 (2) of Schedule 8. Clause 55 (2) sets out the separation distances for a direct fired vaporiser from areas of low and high intensity land use, aboveground tanks and the tank filling connection. The clause mentions a single vaporiser and the separation distances are dependent on the flow rate through the vaporiser i.e. up to 610 litres per hour or over 610 litres per hour. Clause 55 (4) requires the aggregate capacity of the vaporisers to be used when locating multiple vaporisers on a site. This requirement for aggregating the capacity was not part of the previous New Zealand dangerous goods legislation, nor is it included in the legislation of Australia, United Kingdom and the United States of America, or in the requirements of the latest edition of NZS 1596..

The LPG Association on behalf of its members and as part of its LPG reassessment lodged with ERMA has requested this requirement be removed from the legislation. This report looks at the structure of a direct fired vaporiser, their operation, maintenance, multiple vaporiser installations and compares the legislative requirements of New Zealand, Australia, United Kingdom and the United States of America.

STRUCTURE OF DIRECT-FIRED VAPORISERS

Direct-fired vaporisers usually have six basic parts:

1. Enclosure.

2. Liquid reservoir.
3. Burner supply regulator.
4. Burner gas controls.
5. Burners.
6. Maximum liquid lever control assembly.

Enclosure

The enclosure is a sheet metal housing that surrounds all of the working parts of the vaporiser. The enclosure usually has a vent outlet (top), burner air supply louvres (bottom), and some type of hinged or slip-on access door.

The enclosure serves three important purposes. First, it protects the vaporiser from the "elements", such as wind, snow and dust. Second, it provides an inlet for fresh combustion air to the burners. Finally, it provides an outlet for venting the by-products of combustion.

Liquid reservoir

The liquid reservoir of a direct-fired vaporiser is normally a narrow steel tank. Because of its narrow design, the liquid reservoir is normally called a vaporiser tube. Most vaporiser tubes have at least three openings: liquid inlet, vapour outlet, and a connection for a temperature sensing control which cycles the burner(s) on and off. In some cases, the tube also has an opening for a pressure relief valve. As with any application, the pressure relief valve protects the vaporizer tube from excess pressure. Certain vaporisers use two tubes that are manifolded together. In this case, one burner gas control and burner assembly maintains the liquid temperature in both tubes.

Burner supply regulator

Most direct-fired vaporisers use gas burners to provide heat to the LPG liquid in the vaporizer tube. The gas burners normally operate at 2.75 kPa. As a result a regulator must be used to reduce tank pressure to 2.75 kPa. Most manufacturers supply a burner regulator with each vaporiser. The regulator is normally installed on the upper part of the vaporiser enclosure. The type used is either a single stage or combined two stage regulator. The gas supply to the regulator usually comes from the vapor outlet in the top of the vaporiser tube.

Burner gas controls

The burner gas control in a direct-fired vaporiser maintains a uniform LPG temperature by automatically cycling the burners on and off. To do this, the control must perform two functions. First, it must be able to sense the temperature of the LPG in the vaporiser tube. Second, it must be able to cycle the gas flow to the burner assemblies. Most vaporisers use a combination gas valve and thermostat that performs both of these important functions. This combination control is very similar to the type used in gas-fired water heaters.

Gas burners

Typically, vaporisers use two burner assemblies: a pilot burner and a main burner. The pilot burner performs two important functions; first, it is used to ignite the main burner, second it heats a special safety device. The safety device can be either a

thermopile or a thermocouple. When heated, either device will generate a small amount of electricity to operate a pilot safety valve in the burner gas control. In the event that the pilot burner is extinguished, the safety device will stop producing electricity. As a result, the safety valve will automatically close off the flow of gas to both the main and pilot burner.

Unlike the pilot burner, the main burner assembly is the main source of heat for the vaporiser. The most common main burner assembly used is a ring-type burner. The ring-type burner consists of a manifold in the shape of a "wagon wheel". In general, as many as 16 burners are installed around the outside of the wheel and the "spokes". The assembly is positioned so that the heat of the burners is evenly distributed on the bottom of the vaporiser tube.

Maximum level control assembly

The last basic part of the vaporiser is the maximum level control assembly. This assembly fulfills two important purposes. First, it prevents tube from becoming liquid-full during normal operation. Second, the assembly prevents LPG liquid from carrying over into the vapour distribution. In order to perform these functions, most liquid level control assemblies contain two basic parts: a float assembly and a liquid inlet valve.

The float assembly is basically a hollow steel ball that "floats" on the liquid level in the vaporiser tube. The float moves up and down with the liquid level. Most floats rest on or are attached to a lever, which transfers movement to a liquid inlet valve.

MULTIPLE VAPORISER SYSTEM

Care must be exercised in the selection of vaporiser. They should have ample capacity to handle the connected load, plus any future known loads. Often, multiple vaporisers are used, using two or more smaller units to handle the connected load with additional units as spares so that in the event of a failure, service will not be interrupted.

Generally, an economic comparison of the approach weighted against customer needs, will influence final equipment selection.

Why Oversize Vaporisers

1. In general, it is good practice to oversize any mechanical components in a system - remember that ratings are usually given for ideal operating conditions.
2. Deposits and impurities will, over the years, reduce heat transfer.
3. Often the customer is underestimating his load. Also, additional appliances may be added without due consideration to capacity capability of vaporisers.
4. Oversize to take care of overfiring of boilers or other equipment maladjustments.
5. Different manufacturers rate their equipment at different conditions.
6. Remember that the vaporiser burner will be adversely affected if installation is above 600 metres.

7 Oversize vaporisers to offset bad installations (long uninsulated lines, undersized regulators, etc.).
8 Vaporiser burner will lose efficiency over the years unless properly maintained.
9 Lack of maintenance and proper adjustments of controls will adversely affect vaporisers.
10 Variations in supplied LPG may have downgrading effect on the vaporisers.

Assessment of Risk

The question arises as to whether a single large vaporiser separated from the tank by a larger distance is safer than a number of smaller units located closer to the tank. In both installations the supply tank and pipework would be the same. Each vaporiser would be independent and as they can be individually isolated they should be treated as independent tanks which are not interconnected. Therefore multiple vaporisers should be separated based on their individual flow rate and not the aggregated quantity. Direct fired vaporisers are a source of ignition and are required to be sited outside the hazardous area zone for the tank so in this respect the isolation distance increases with the size of the tank. Also whether there is a single vaporiser or multiples, they will all be fed from the same LPG tank supply. So the ultimate potential for energy release is the same and the emergency shutdown system on the tank if operated will cease all supply regardless of the number of vaporisers.

Multiple vaporizer installations are common in Australia and USA; there are no requirements for requiring the total capacity to be taken into account when siting the installation. There have been no studies undertaken to compare the siting of multiple vaporisers with larger capacity unit. It is preferable to have the multiple set up to ensure continuity of supply during maintenance etc.

LOCATION LEGISLATION

New Zealand

Regulation 76 (2) of the Dangerous Goods (Class 2 – Gases) Regulations 1980 required vaporisers to be isolated as follows:

(2) Except as may be approved by the Chief Inspector no vaporiser that is direct fired or could be a source of ignition for flammable gas shall be located closer than –
  (a) 15m from any tank used for the storage of dangerous goods of class 2 (d) or any filling connection for that tank or from any protected work or public place where the capacity of the vaporiser is greater than 500 litres per hour; or
  (b) 8m where the vaporiser is of lesser capacity.

There was no requirement for aggregating the quantity when installing the vaporisers. It refers to the flow through a single vaporiser only. Multiple vaporisers with a flow of less than 500 litres per hour could be sited together 8 metres from the tank, protected works and public places.

Clause 20 (3) Part 3, Schedule 10, Gazette Notice 35 (as amended) requires direct fired vaporisers to comply with the requirements set out in clause 55 (2) of Schedule 8 of the Gazette Notice. The siting requirements are:

(2) Every vaporiser that is direct fired or may be an ignition source, and is used to vaporise a liquefiable gas, must be installed-
  (b) for a liquefied petroleum gas vaporiser with a capacity of 610 litres per hour or less, not less than 8 metres from-
    (i) an area of low intensity land use or an area of high intensity land use; or
    (ii) an above ground stationary tank used to store liquefied petroleum gas; or
    (iii) the filling connections of a tank referred to in subparagraph (ii); or
  (c) for a liquefied petroleum gas vaporiser with a capacity of greater than 610 litres per hour, not less than 15 metres from-
    (i) an area of low intensity land use or an area of high intensity land use; or
    (ii) an above ground stationary tank used to store liquefied petroleum gas; or
    (iii) the filling connections of a tank referred to in subparagraph (ii).

(4) A vaporiser that is direct fired or may be an ignition source and is located together with 1 or more other such vaporisers, the separation distance under sub clause (2) must be determined based on the aggregate capacity of the vaporisers grouped together.

Australia

AS/NZS 1596:2002 The storage and handling of LP Gas

4.10.3 Location

The separation distance of a direct fired vaporiser from a protected place or public place shall be not less than the following:

(a) For a vaporiser having a vaporising capacity of 70 L/h or less 3 m.
(b) For a vaporiser having a vaporising capacity over 70 L/h and up to 500 L/h 8 m.
(c) For a vaporiser having a vaporising capacity exceeding 500 L/h 15 m.

NOTE: A direct-fired vaporiser is considered as an ignition source.

These requirements are included in clause 6.9.3 of the 2007 draft edition of the standard. There are no requirements for aggregating the capacity of the vaporisers.

United Kingdom

Highly Flammable Liquids Regulations 1972

The separation distances for direct fired vaporisers in the UK are set out in the following table.

Minimum Safety Distances of Direct Fired Vaporiser from Storage Vessel

Water capacity of storage vessel Litres	Minimum Distance Metres
Over 1125 to 2250	3
Over 2250 to 9000	7.5
Over 9000 to 135,000	15
Over 135,000 to 377,500	22.5
Over 377,500	30

Minimum Safety Distances of Direct Fired Vaporisers from Nearest Important Building or Line of Adjoining Property

Capacity of vaporiser kg/hr	Minimum Distance Metres
Up to 36	3
Over 36 to 227	7.5
Over 227	15

There are no requirements for aggregating the capacity of the vaporisers.

United States of America

NFPA 58 Storage and handling liquefied petroleum gases

Minimum distances from the vaporiser to:

Container	3m
Building housing gas-air mixer	5m
Container Shutoff Valves	5m
Point of Transfer	5m
Other buildings / property line	8m
Building housing gas-air mixer	3m

There are no requirements for aggregating the capacity of the vaporisers.

SUMMARY

Based on overseas legislation and previous NZ dangerous goods regulations there does not appear to be any reason as to why the aggregate capacity of the vaporisers must be used when siting the equipment. Literature from Australia and the USA show multiple installations of between 4 – 6 direct fired vaporisers 8 metres from storage tanks.

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