

ENVIRONMENTAL RISK MANAGEMENT AUTHORITY



NGĀ KAIWHAKATŪPATO WHAKARARU TAIAO

**Report of Inquiry into the
Use of LPG Cylinders in
Indoor Situations (INQ03014)
To ERMA New Zealand**

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Executive Summary

The Terms of Reference for this Inquiry, dated 4 December 2003, were prepared by ERMA and agreed by OSH and ESS. I began the inquiry on 16 December 2003.

My inquiry focused on the indoor domestic use of LPG cylinders in New Zealand and prevention of gas leakage and misuse of equipment resulting in fires, injury and death. As at 4 January 2004, the Energy Safety Service had records of 503 separate incidents involving the indoor use of LPG cylinders. Since 1992 there have been some 30 to 50 incidents per year. Of these, 25% have involved mobile LPG heaters. In the year 1 July 1998 to 30 June 1999, of the 50 mobile LPG heater incidents recorded for that year, 6 resulted in structural fire damage of property, and of these 6, 3 had the mobile heater in the bedroom.

Of all the mobile LPG heater incidents where a cause has been able to be identified, over 60% have been attributed to faults in the connection systems between the cylinder and the appliance. There is also a strong indication (maybe as much as 30% of all incidents) of misuse of the heater appliance by the residential user through having the heater too close to combustibles, and through lack of maintenance and care of the system. The other major cause has been cylinder overfills (6% of the incidents).

I considered feasible options for the prevention of these incidents and after evaluating them, concluded that safe use of mobile LPG heaters would require a series of changes. These include:

- modifying the QCC valve to prevent POL fittings being connected,
- changing the methods of approving valve and fittings,
- linking the reporting of incidents with the approvals process,
- improving the use of equipment in the home and at fillings stations, and
- improving the care and maintenance of equipment and appliances.

Although the inquiry has had a focus on the mobile LPG heater, the comments relating to valves and fittings relate equally to stoves/hobs connected to 9kg LPG cylinders, and to patio heaters and BBQs and grills.

I conclude that with the implementation of the following recommendations, the causes of incidents referred to above can be substantially reduced to less than 30% of the current incident level.

The series of recommendations arising from this inquiry is as follows:

Recommendation 1

THAT there should be one reliable database of incidents for indoor use of LPG cylinders compiled from the ESS, NZ Fire Service and ERMA databases. These three databases should continue to provide the functions for which they were created.

Recommendation 2

THAT a Code of Practice for Indoor Domestic Use of LPG cylinders be prepared and approved by ERMA.

Recommendation 3

THAT a new QCC OPD valve, without the POL screw, be approved for use in New Zealand. The specification for this valve to include the design features now considered acceptable for NZ use.

Recommendation 4

THAT all the old style QCC valves, which have identified problems, be recalled and replaced with the new QCC OPD valve. Existing QCC valves of good design, but still with the POL internal screw, to be left in service.

Recommendation 5

THAT AS/NZS 1596:2002 " The Storage and Handling of LP Gas" be reviewed and approved by ERMA for use in New Zealand.

Recommendation 6

THAT all cylinder testing stations be equipped with facilities to test and service valves.

Recommendation 7

THAT all cylinder valves be tested or replaced (if that is the cheaper option) at the same time as the 10 year cylinder test.

Recommendation 8

THAT all LPG cylinder filling station operators be approved fillers.

Recommendation 9

THAT all retail outlets for cylinders and appliances be required to issue soapy water leak testing bottles and instructions, with all new equipment purchased, and filling stations be required to offer soapy water leak testing bottles and instructions, with each cylinder refill.

Recommendation 10

THAT ERMA introduce controls for the above recommendations through the gazetting process once the Compressed Gas Regulations are introduced.

Recommendation 11

THAT a publicity campaign be implemented prior to winter 2004 targeting all indoor LPG cylinder users to highlight the need for leak testing, prevention of flammable clothing next to heaters, ventilation of heated rooms, correct control of the heater, and banning heaters in bedrooms, maximum quantity of stored LPG indoors, and the need to replace QCC valves with identified problems.

Recommendation 12

THAT the OSH "Guide to Gas Cylinder" document be updated and reissued for use by the test certifiers under the Compressed Gas Regulations.

Recommendation 13

THAT fittings approvals be specific as to the assembly system to ensure compatibility, and that approvals be for a stated period until recertification.

Recommendation 14

THAT there be one approval agency for all the components in the mobile LPG heater system.

Recommendation 15

THAT the enforcement agency responsible for approving the components in the mobile LPG heater be empowered to respond to the findings arising out of investigations undertaken under the Gas Act 1992.

Recommendation 16

THAT a detailed risk assessment be undertaken to quantify the benefits and the costs specifically for Recommendation No 4.

I consider that it is feasible to begin implementing the above recommendations in 2004.

Abbreviations & Definitions

Abbreviations

ABER	Alan Brown Energy Resources
AS	Australian Standard
BBQ	Barbecue
BS	British Standard
CEN	European Standard
COF	Certificate of Fitness
CTLA	Cylinder Testing Laboratories Association
ERMA	Environmental Risk Management Authority
ESS	Energy Safety Services, Ministry of Consumer Affairs
HSNO	Hazardous Substances and New Organisms
IRL	Industrial Research Limited
LPGA	LPG Association of New Zealand (Inc)
LPG	Liquefied Petroleum Gas
MED	Ministry of Economic Development
NZS	New Zealand Standard
OPD	Overfill Protection Device
OSH	Occupation Safety & Health, Department of Labour
POL	Prest-O-Lite (Prestolite)
QCC	Quick Closing Coupling
SMF	Sustainable Management Fund, Ministry for the Environment
UL	Underwriters Laboratories Inc

Definitions

Accident	An unforeseen and unintended event resulting in loss.
Fitting	The same definition as in Clause 3, Interpretation, of Compressed Gas Regulations 2004.

Incident	An event that under different circumstances could have resulted in loss (i.e. a "near miss" event).
Mobile Heater	A heater appliance that contains a LPG cylinder in its structure, and is able to be moved.
Portable heater	A heater that has a hose connection to a piped LPG distribution or natural gas distribution system (bayonet fitting) in the dwelling, and is able to be moved.

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ABER	Alan Brown, Gregg Brown, Sami Cohen
BBQ Factory	Ian Gallagher
Ceodeux Inc	David Lawson
CTLA	Doug Peattie
ERMA	Geoff Mayes, Peter Dawson
ESS	Tony Smith, Jim Green, Vallabh Patel, Mehdi Yassaie
Galpro Stylex	Grant Wallis
Gas Fire & Cylinders	Ken Walker, Dave Parker
IRL	David Firth
LPGA	Peter Gilbert
Manchester Tank	Tom Freeland
MfE	Dick Burgess
NZ Fire Service	Paula Beaver, Neil Challands
On gas	Alistair Pollock
OSH	Peter Williamson, Ron Andrew, Kim Comben
Rinnai	Tony Gregory, David Hewitt
Tank Testing Laboratories	Martin Sefton
The Warehouse	Peter Jackson
Ward's Cylinder Service	Lex Ward, Mike Synnott

1. Scope of Inquiry

1.1 Terms of Reference

The Terms of Reference for this Inquiry, dated 4 December 2003, are included in Appendix A. These terms of reference were agreed by ERMA, OSH and ESS at meetings held in ERMA offices on 10 and 16 December 2003 respectively.

1.2 Comments on the Terms of Reference

1.2.1 Indoor Use of LPG Cylinders

My inquiry concerned the use of LPG cylinders of capacity less than 10kg, for indoor use in New Zealand in domestic residences mainly associated with mobile heaters and hobs/stoves. The cylinder sizes comprise the 4kg, 4.5kg and 9kg net capacity range of cylinders.

There are other uses for these cylinders linked to patio heaters, BBQs and grills, outdoor lights, and for caravans, motor homes and boats and light commercial, but these uses lie outside of this inquiry.

The use of these cylinders linked to commercial and trades applications are also excluded.

1.2.2 My inquiry was not concerned with the use of 45kg cylinders which are installed usually as a paired arrangement on an external wall in domestic and commercial premises. This situation requires the use of registered gas fitters for the installation and the cylinder fittings are of the POL type and not of the quick closing coupling (QCC) or clip on types which characterise the smaller indoor cylinder use in New Zealand.

1.2.3 My inquiry's main focus was the cause of accidents and incidents arising from gas leakage, often resulting in fires, and the prevention of such incidents. As a part of my review, my inquiry also addressed the issues of operator misuse and inadequate maintenance of equipment.

1.2.4 My inquiry did not address the impact of unflued gas heaters on the indoor environmental air quality such as accumulation of moisture, carbon monoxide, carbon dioxide, particulates, nitrogen compounds and other asphyxiants. Where relevant, I comment on ways to mitigate the undesirable effects. Research is currently being undertaken in New Zealand to quantify some of the characteristics associated with unflued gas heaters (1).

My report does not detail the history of the LPG cylinder and associated mobile heater development in New Zealand but focuses on the existing national stock and the range of equipment in use with the need to make it safe.

1.3 Risk Analysis

My report does not aim to undertake a comprehensive risk analysis of the use of LPG cylinders in indoor situations, but I will comment on the reduction in risk resulting from adoption of the recommended changes.

2. Review of Incidents in New Zealand involving LPG Cylinders Indoors

2.1 History of the Mobile Heater in New Zealand

The introduction of the LPG mobile heater into New Zealand occurred in the mid 1970s with a heater supplied by Rinnai NZ Ltd(2). Since that time, the use of mobile heaters has developed in response to the NZ Government's call for utilisation of the new LPG resource from the exploitation of the Maui Gas field. The number of mobile heaters in use became significant in the 1980s when the first incident reports(3) began emerging of leakages from the cylinder and fittings.

It was in the 1990s that substantial numbers of heaters were purchased in NZ and this was reported at the LPG Association Conference in 1997(4). In 1996 and 1997 there were some 60,000 to 70,000 heaters sold each year and the LPGA assessed that 535,000 heaters had entered the market since 1976. Allowing for a 10 year life for the heater, the LPGA assessed that greater than 470,000 heaters were in use in NZ in 1997. Since that time, the sales have reportedly reduced and there were some 30,000 to 40,000 sold in 2002. The LPGA estimate that the stock in current use is likely to be greater than 500,000, but no actual totals have been verified.

The ESS has assessed from data supplied by the Department of Statistics that in 2001, there were 361,000 households that used LPG heaters(5). Some of these could have more than one mobile LPG heater in the house. Allowing for some 100,000 new heaters since that census time, there could be approximately 450,000 households with mobile LPG heaters in 2004.

Since 1975, the systems of connections used for the cylinder to the heater appliance have reflected the various commercial options generally available from overseas. This has led to a number of approved fittings for use in New Zealand including valves, regulators, probes and adaptors(6). However, experience of the various systems has demonstrated that mixing the systems with/without adaptors has not been successful in providing leakproof connections.

The evolution of these systems in New Zealand has led to three connection systems which dominate the market, namely the QCC, the clip on and the POL systems. These systems are offered by most of the heater appliance suppliers. There is also a stock of other fittings and various adaptors which have been developed to connect to QCC valves because the QCC valve allows for POL fittings.

2.2 Database of Incidents

2.2.1 Energy Safety Service (ESS)(3)

The most comprehensive database of incidents involving LPG cylinders used indoors has been compiled by ESS. At the time of writing, this database recorded 503 separate incidents up until 4 January 2004.

The records for each incident are quite variable in terms of the details of the equipment, the operating parameters at the time of the incident, the condition of the equipment, and the cause of the incident. The best reports provide good descriptions of the equipment, including the name and model, serial numbers, date of purchase, cylinder size, type and inspection stamps, and also the cause of the gas leakage or fire.

This database records that there have been 6 deaths as a result of fires from the incidents, and 7 people have been hospitalized with carbon monoxide poisoning.

There is also data of an additional 12 incidents associated with LPG in caravans, cars and tents, in which 18 deaths have occurred from carbon monoxide poisoning.

2.2.2 NZ Fire Service

The NZ Fire Service has a database of all incidents attended from which they have separated out the LPG incidents. This database begins at 02/07/1998 and includes incidents up until 01/07/2003(7). However, this database is not complete as there was an industrial stoppage in 1999-2000 which prevented the reporting of many incidents in that period.

There are 237 separate LPG mobile heater incidents and 51 LPG cooker/range top incidents reported in the database over this five year period. Because many of the incidents were reported without details of the equipment, condition factor of the equipment or an analysis of the cause, this database has less significant information compared to the ESS database.

The database has value in identifying some downstream impacts of malfunctioning equipment and misuse of appliances, such as structural fire damage to domestic properties.

I undertook a comparison of the ESS database and the NZ Fire Service data base over the same period, that is for the 12 month period 1 July 1998 to 30 June 1999, Of the 50 mobile LPG heater incidents in the NZ Fire Service data base, 44 were identified in the ESS data base, 6 were structural fires with damage, and in 3 of these, the mobile LPG heater was in a bedroom.

2.2.3 ERMA Database

ERMA has a database of all hazardous substances incidents which begins in June 2000 and records reports from Local and Territorial Authorities, through their Dangerous Goods inspectors, and from the media. The database(8) has 1053 reports up to 21 January 2004, but I have not been able to establish from this database how many separate LPG incidents have occurred. Geoff Mayes has demonstrated to me how the database can be interrogated to get specific data but at the time of this report, I have not been

able to get the data corresponding to mobile LPG heaters and other indoor uses of LPG cylinders.

I do not know the extent to which the above three databases overlap, but the ESS and the ERMA databases should have the same incident basis.

2.2.4 ABER Data

Alan Brown Energy Resources 1988 Ltd (ABER) have taken the ESS database for the period 23/04/1992 up until 13/06/1997 and have analysed the 178 incidents in this period to ascertain the prime cause of the incidents(9). However, this analysis has not been extended to all the ESS database incidents. The data does cover the period in the mid 1990s when the QCC connections were introduced into NZ.

2.2.5 LPG Association

The LPG Association has used data from the ESS database over the period 01/01/1992 to 1997 in compiling their 1997 Annual Conference Report (4). This represented 169 separate incidents.

The LPGA also analysed data from 216 incidents from the ESS Database for the period 1994 to 1999(10) and this analysis is discussed in the next section.

3. Causes of Incidents

3.1 Use of Database Information

3.1.1 ABER Analysis(9)

ABER analysed 178 incidents from the ESS database for the period 22/04/1992 until 13/06/1997 under 10 categories and reported as follows:

		<u>%</u>
Faulty regulator	16	9
Faulty adaptor	8	5
Over-filled cylinder	9	5
Loose adaptor	2	1
Leaking cylinder	6	3
Heater too close	25	14
Heater tipped	1	1
Faulty part/break	48	27
No reason	48	27
Misuse/lack of maintenance	15	8
	<i>178</i>	<i>100</i>

Of the above incidents, 16 led to human injury including 3 deaths.

3.1.2 LPG Association of New Zealand (10)

At the LPGA 1997 Annual Conference, it was reported that of 169 incidents with LPG cylinders and mobile heaters over the period 1 January 1992 until 1997, the suspected causes were:

		<u>%</u>
Leaks from adaptors/regulators	115	68
Heater too near combustibles	34	20
Operator error/misuse	13	8
Cylinder overfills	7	4
	<i>169</i>	<i>100</i>

3.1.3 LPGA

In a further analysis of incident data in the period 1994 to 1999 undertaken by LPGA and reported to my inquiry on 22 December 2003, the break down of 216 separate incidents was categorised as follows:

		<u>%</u>
Leak at adaptor/regulator	122	56
Leak from cylinder	10	5
Combustible material	38	18
Overfill	15	7
Heater not the cause	1	0.5
Undetermined	14	6.5
Misuse/error	16	7
	216	100

3.2 Discussion of Causes of Incidents from the above Database information

3.2.1 None of the above three analyses identified the type of connector involved in the incident, and I suspect that even with a thorough study of the ESS database, this information might only be available in part.

3.2.2 From the above analyses, I have grouped the results into four categories to assist me in focusing on the chief causes of the incidents. These are:

Faults in Connector System.

There is a strong indication that some 50% of the incidents could be attributed to faults in the connection systems between the cylinder and the appliance.

This finding is also arrived at by Tony Smith(10) although he qualifies this by saying the range could be from 39%(12).

Misuse of Equipment.

There is strong indication (maybe as much as 25% of the incidents) of misuse of the heater appliances by having them too close to combustibles, and inadequately maintaining and caring for them.

Cylinder Overfills.

The other main cause is cylinder overfills (approximately 5%).

Undetermined Causes.

Undetermined causes make up the balance of the incidents (some 20% of all incidents).

3.2.3 The above groupings of results are consistent across the three analyses provided in 3.1. They do indicate where the emphasis could be placed for reducing the incident rate for indoor use of LPG cylinders.

- 3.3 Frequency of Incidents on Monthly Basis
ESS has analysed the monthly frequency of 492 incidents for the years 1993 to 2003 and the results show that the incidents peaked in June (100 incidents) and diminished to 8 in February, for this period(11). This indicates that the predominance of LPG incidents occur during the winter months as is expected with the use of mobile heaters.
- 3.4 Geographic Distribution of Incidents
ESS has analysed the geographic spread of incidents in NZ over this same period(11) for 15 Territorial Local Authorities and found that except for Christchurch, all Territorial Local Authority regions had a similar occurrence of incidents of between 5 to 10. Christchurch, in comparison, had 32.
- 3.5 LPG Cabinet Heater Accidents
ESS has investigated the incident data(12) for LPG cylinder use in buildings in the period 1996 to 2003, which were in the ESS and the NZ Fire Service data bases, and reported that there were 325 LPG cabinet heater incidents, 58 LPG cooking incidents (ovens, cookers and barbeques indoors), and 62 natural gas heating incidents (appliances indoors).

The analysis showed the fatality rate was 0.1 deaths per 100,000 LPG heating households per year, and the injury rate was 0.9 injuries per 100,000 LPG heating households per year.

ESS also commented that there are a large number of non-reportable incidents that may have escaped the reporting to databases, and that minor LPG cabinet heating incidents are more likely to be reported than equivalent LPG cooking incidents.

- 3.6 Reports from Cylinder Testing Stations
A number of cylinder testing stations in New Zealand have reported to the CTLA their experience during 2003 with inspections of cylinder valves as noticed when undertaking the mandatory testing of 9kg cylinders. I visited a few of these stations as part of this inquiry to discuss with the proprietors the nature of their experience and any suggestions that they might have to remedy the problems.
- 3.6.1 Ward's Cylinder Service Centre, Lower Hutt(13)
Lex Ward has had an extensive experience of servicing cylinders with valves from various suppliers. The Kosan valves and clip on regulators appeared to have given few problems, whereas the introduction of the QCC valve has given rise to many damaged and leaking valve and regulator assemblies. The main problems appear to be intermittent leaks with the QCC valves, many having to be replaced because of damaged face and back check module seals. Both seals can be damaged by over-tightening of POL inserts such as regulator bullnose probes and filling probes.

3.6.2 Tank Testing Laboratories, Manukau City(14)
Martin Sefton, Manager, has had to replace many QCC valves because of damaged back check module seals. He says the problem has occurred because the QCC valve has the internal POL screw thread and this allows the cylinder filling stations to use POL filling probes which can damage the valve internals. Martin said that if the internal POL screw thread was removed, this would prevent damage to the valve by the filling probes or other POL inserts and adaptors.

3.6.3 Gas Fire and Cylinder Services, Tauranga(15)
Ken Walker and Dave Parker have a display of damaged valves that they have had to replace when servicing the 9kg cylinders. They have reported their experience to CTLA and OSH(16) which can be summarised as follows:

Total QCC valves replaced 1 April 2003 to 30 Nov 2003 83

Damage to face seal	54
Internal thread unscrewed	15
Non-return failure	14

Both Ken and Dave stated that the damage was caused by POL fittings being screwed into the valve.

3.6.4 Indicative Listing of Cylinder Testing Station Reports to CTLA and OSH
There are 44 cylinder testing stations in NZ(10). Several reported their experience with replacing QCC cylinder valves in 2003(17). The reports do not cover the same monthly period and generally are from 1 April 2003 to November 2003. The information is indicative of the need to replace valves but would have been more informative if all valves replaced were recorded rather than just QCC valves. Only one station reported replacement of other valves.

Station	Number QCC valves Replaced	
	2002	2003
Cylinder Testing Services, Dunedin	35	37
H.B.Cylinder Testing Station, Hastings		26
Gas fire & Cylinder, Tauranga		83
New Plymouth Underwater, New Plymouth		12
Fire International		42
Cylinder Testing Gisborne, Gisborne		26
Rockgas	*	72
Cylinder Testing Centre Ltd, Rotorua		17
Tauranga Cylinder Servicing, Tauranga		18
FireWise Ltd, Palmerston North		4
Nelson Fire Protection, Nelson		11
Northland Cylinder Testing, Whangarei		60
Gasworks Ltd, Hastings		43
Tank Test		28

* Also replaced 268 POL valves in the same period.

The comments associated with most of these reports identify the insertion of the POL filling probe or POL screwed regulator probes or adaptors into the QCC valve as the prime cause of damage to the QCC valve.

3.6.5 OSH Questionnaire

OSH sent out a questionnaire to all cylinder filling stations in November 2003 asking them to advise the number of QCC valves that they replaced during the period 1 December 2003 to 31 January 2004. This period corresponds to the summer time use of the cylinders, which will be predominantly for BBQ and grill use. However, the same problems should be evident from misuse of the filling probes and insertion into the QCC valve of other POL screwed connections.

The response from 15 stations was collated by OSH (18) and I have summarised the findings as follows:

Of the 73 valves replaced in the two month period, the main causes of valve damage appear to be:

shuttle (back check module) jammed/leaking	32
valve leaking generally	21
broken handwheel	10
leak at handwheel	3
other faults	7
<i>Total</i>	<i>73</i>

The reasons given for the damage were varied and interesting:

- Kosan clip on fitting screwed into QCC jamming the shuttle
- Handwheel stripped because valve not turned off, and someone used a spanner to try to open valve
- Cracked plastic handwheel
- Filling station adaptor causing back check module damage
- POL fittings screwed into valve and overtightened

The majority of the damage to the shuttle(back check module) was stated by several testing stations to be caused by POL fittings being screwed into the valve.

3.6.6 Comments on Cylinder Testing Station Reports

The number of valves being replaced when cylinders came in for their 10 year testing occur across all the valve types. The QCC valves are particularly identified because of the OSH questionnaire requirement, so the returns are not representative of all valve replacements.

The most prominent comment is that the QCC valves are being damaged by the insertion of POL fittings which can be screwed in with a spanner and which can damage both the face seal and the back check module seal. This can also cause the back check module to become unscrewed when the POL fitting is removed. The insertion of the POL probe can occur at the cylinder filling stations or at the user's residence where BBQ and appliance fittings, not of QCC origin, are fitted directly or through an adaptor.

The filling station probes can exert considerable leverage on the valve and this has led to damaged face seals and back check module seals.

3.7 Failure Investigations

IRL has undertaken two valve failure investigations at the request of ESS and in particular, the investigation into QCC Fittings was reported on 19 June 2002(19). The conclusions reached in this report identified several design features of the QCC valves and fittings, sourced from different manufacturers, which were suspect and likely to give rise to leaking components.

The reasons for leakage from the QCC fittings are:

- The use of filling probes which had POL probes screwed into the valve causing damage to the face seal.
- The damage that could occur if the regulator probe was able to rotate against the face seal causing tearing of the seal.
- The shape and support of the face seal could make damage to the seal possible depending on the shape of the regulator bullnose probe.

The report indicated that care had to be taken in approving the valve and fittings because of the potential for damage with some products. The author, David Firth, also said that in his opinion, there were design aspects of the QCC valve which he considered not good practice and which would give rise to leaks.

IRL has also investigated the valve and connection which were in the Hastings fire in 2003 but I do not know the outcome of this investigation.

David Firth has not been asked to investigate other valve and connection systems so he could not compare the technical attributes of the various systems.

3.8 QCC Improvements

I have discussed the IRL findings with ABER and have been told that the IRL report was distributed to the three manufacturers that ABER use for their QCC products. The outcome was positive as the various design features identified by David Firth as being suspect have been addressed in the latest QCC products, and ABER believe the most recent QCC products offer the most safe system available in New Zealand.

3.9 Acceptable QCC Valves

In a meeting held in Wellington on 5 May 2004, Kim Comben said that in his opinion, the latest QCC valves as supplied by Cedeaux, SCG and Omeca had a circlip or restraint which prevented the back check module from unscrewing and he had not heard of any problems with these valves. These valves also incorporated the design changes which were flagged as being necessary in the IRL report (19).

4. Options for Prevention of Incidents

4.1 Options

Options that I consider could mitigate the problems with mobile LPG heaters in NZ are:

- a) Ban Mobile LPG Heaters
 - ban all mobile LPG heaters
- b) Legislate for Connection System
 - make one connection system mandatory for all indoor appliances
 - make the QCC valve unable to accept POL probes
- c) Maintenance and Servicing
 - create a system where all cylinders and valves are owned by a specialist LPG provider, who also fills the cylinders
 - make servicing of all equipment mandatory under a Certificate of Fitness regime
 - fit all cylinder test stations with facilities to test valves and regulator connections
 - mandatory replacement of all cylinder valves and regulator probe assemblies on a regular basis
- d) Filling Station Controls
 - regular auditing of all LPG filling station operations
- e) Public Education
 - make the general public more safety conscious in the use of leak testing
 - undertake a regular audit of all domestic use of indoor LPG cylinders
- f) Code of Practice
 - prepare a Code of Practice for indoor use of LPG Cylinders and associated appliances
 - create a NZ Standard for the Use of Indoor LPG Cylinders and Associated Appliances
- g) Review Enforcement Processes
 - review the approvals and investigating/reporting processes to ensure feedback for corrective action

4.2 Discussion of Options

4.2.1 Ban Mobile LPG Heaters

The number of mobile LPG heaters in use in New Zealand is about 500,000(10) and because the general public perceive the LPG mobile heater to be a low cost option for heating, the number in use is expected to increase. The capital cost of heaters is less than for woodfires such as Kent or for fixed gas and flued appliances. However, the operating costs of using LPG for heating may not be lower than other forms of heating

If banning LPG heaters was mandated, many existing users could be seriously disadvantaged. For example, to immediately install alternative LPG heating such as fixed flued, unflued or portable heaters, would impose

a logistical problem for manufacturers and installers because of the large numbers of new appliances required and the need to use gas fitters for the installations.

4.2.2 Legislate for Connection Systems

- (a) **Make One Connection System Mandatory for all Indoor Appliances**
For this option, I propose that one preferred connection system be mandated for all indoor appliances, so that there are no mismatching of competing systems.

This option overcomes the problems with the multitude of valves and connections in use, which are not compatible. Mismatching systems leads to damaged valves with the subsequent leakage of LPG and possible fires. The question arises as to which connection system is preferred, and how is the situation to be put in place in a reasonable timeframe. This is discussed in Section 5.

There is the question of the cost to replace the out-of-specification components that are owned by the consumer. Although there is no readily available information on the numbers of different valves and fittings in use in New Zealand, I assume for this present purpose that there may be 50% of all heater appliances that would need to have the connection systems replaced, including the valve on the cylinder. With 44 cylinder testing stations able to undertake this work, this amounts to some 6000 conversions per station. This represents a considerable additional work load to the 100,000 cylinders that are required to be tested this year (my estimate based on there being over 1,000,000 9kg cylinders in use and 10% requiring retesting for the 10 year test).

- (b) **Make the QCC Valve unable to accept POL inserts**
This option overcomes the existing problem with damage caused to QCC valves through the insertion of POL screwed probes. The valve manufacturers have advised⁽²⁰⁾⁽²¹⁾ that it is a reasonably simple modification for them to make and introduce. It would be quicker to introduce if UL approval was not required for the modification.

I consider that all existing QCC valves should be replaced or there would still be a repeat of present problems with POL inserts into the current stock of QCC valves. I do not consider it is a cost effective solution to machine the POL screw thread out of existing QCC valves because the valve would require disassembling to inspect the internals and to ensure no swarf is entrained. It would be cheaper to purchase a new valve which ABER have advised has a wholesale cost of \$28 for the OPD QCC valve.

ABER advise that the wholesale cost of replacing the regulator probe with a QCC probe is \$10. Based on an assumption that there are 1,000,000 9kg cylinders in use in NZ, and 100,000 of these are due for their 10year retest in 2004, I assess that 50% of these would require to be fitted with the new QCC OPD valve if the change over was mandated as from 1 July 2004.

If all other cylinders were mandated to have their QCC valves changed, and if 50% of all cylinders had these valves, then assuming there are 500,000 mobile LPG heaters and half have QCC connections, there could be some 250,000 cylinders with the old QCC valve requiring replacement.

The manufacturers of these valves do not envisage a problem with being able to produce the numbers of valves required within a short period as the production lines can produce some 1000 per hour. I have not investigated the need to get UL approval for the modification or if Kim Comben would consider introducing the valve without UL approval.

4.2.3 Maintenance and Servicing

(a) Dedicated Provider of Filled Cylinders

This option requires a specialist company who owns and provides all cylinders and valves, and who also fills the cylinders preferably on an automated filling system. This option would be similar to the situation in the UK and Ireland where ownership of cylinders and valves stays with a specialist provider, and customers swap empty cylinders for filled ones. The advantage of this scheme is that the filling operation would be closely controlled using approved fillers, and filled cylinders would have damage free valves because of the specialist's warranty provisions.

There is a current operator in NZ (On gas) who runs a swap-a-cylinder scheme but this operation is likely to disappear⁽²²⁾ because On gas does not own the cylinders, and is often faced with needing to repair damaged valves and cylinders at On gas's own cost. There is no testing of the returned cylinder or valve at the time of the cylinder swap, and hence there is a risk of not recovering the repair and replacement costs from the consumer.

On gas have advised that because of NZ's lack of critical mass for a scheme like that in the UK, and the high distribution costs⁽²²⁾, there is not likely to be operators prepared to set up such a scheme in NZ. This assumption needs to be tested but it implies that a monopoly supplier might be the only way to make this a viable option.

- (b) COF Scheme for all Mobile LPG Cylinder heaters and connections
This option aims to overcome the problems of leaking valves and connections by insisting on the consumer having regular servicing checks of that equipment in order to gain a Certificate of Fitness. This could be linked to fire insurance cover which would be voided without a current COF. I have discussed this possibility with the Insurance Council of New Zealand (Inc) and they advise that they have not considered this as an option for their members(23).

Although this option would achieve the purpose of making consumers more aware of the need for regular servicing, it would be unenforceable, and would not avoid the problems that arise from damage to valves through using the incorrect fittings, or poor filling station procedures.

Comments from Peter Morfee, MED(24) about attempts to have such a scheme operate in the electrical industry suggest that it is impractical in the domestic situation. Success has been obtained when specific sectors in industry are targeted, such as medical facilities, but not for the domestic scene.

- (c) Equip All Cylinder Test Laboratories with Valve Testing Facilities
The existing cylinder test laboratories undertake cylinder testing only, but are often called upon to check for damaged valves. If each station was equipped with rigs for valve testing, then customers could avail themselves of this service and have faulty equipment replaced if necessary. The reports from cylinder testing stations to OSH over the last year indicate(17) that there are a substantial number of valve replacements being undertaken by all stations, but these are probably associated only with cylinders undergoing their 10 year mandatory test. In the event that a customer wishes to change from POL and clip on connections to QCC connections, then these testing stations would be appropriately placed to offer this service.

It might be that only the seals need replacing in the valves, and this might be a cheaper option for customers than total valve replacement.

- (d) Mandatory Replacement of all Valves and Regulators at Specified Age
This option assumes that valves and regulators become more unreliable with use and age, and by mandatory replacement, say every 10 years, there will be fewer problems with leaking valves and connections.

In my opinion, the problems being experienced with damaged QCC valves are more likely to be caused by using POL connections. The ANSI Z21.81-1997 Standard "Cylinder Connection Devices" calls

for valves to be tested without fail for 10,000 operations of opening and closing the connection. A normal use of a valve in a domestic situation might be it is used twice per day, to simply open and close off the gas supply, and this would amount to some 700 operations per year. Replacing the valve at say a 10 year life might be well inside its use by date.

4.2.4 Filling Station Controls

(a) Regular Auditing of All LPG Filling Station Operations

Since 2001 the LPGA has run training programmes for the LPG filling stations throughout NZ. Peter Gilbert advises that this has operated through 4 national trainers who train about 200 site trainers for the 630 petrol stations which dispense LPG. The site trainers need to get retrained every 2 years to hold their Certificate. It is up to the site trainers to supervise the staff who dispense the LPG.

There is however, no requirement that each and every filling operator on the service station forecourt, holds a certificate of fitness to undertake the filling operations. There are many examples of dangerous practices which have led to incidents ranging from overfilling, leaving ullage screws untightened, leaving valves opened, and using POL filling probes in QCC valves.

The problem is not the training programme and its content, but the lack of suitable supervision of all the operators who dispense LPG.

This could be improved by a frequent auditing of the station operations with feedback to the station owners. The LPGA comment that maybe as many as 30% of all filling stations are not meeting the training programme requirements.

(b) Approved Fillers

Another option is for all fillers to be approved fillers. This is preferable as it also means that the filler would be trained to inspect valves for damage and refuse to fill cylinders with faulty valves. By either (a) or (b) above, it should be possible to avoid the 6% of incidents which have been attributed to overfilling.

4.2.5 Public Education

(a) Make Leak Testing User Friendly

The general public may know of the recommended soapy water leak test to check for leaking connections, but it is not a practice that is widely used. In my opinion, the practice is not used because the container with the soapy water solution is not readily at hand at the appliance or the LPG cylinder. If each time a connection was made between the cylinder valve and the regulator probe by a member of the general public the connection was leak tested, then many of the

incidents where leakage was cited as a cause might be avoided, because the appliance would not be switched on. Also, damaged valves could be identified for servicing or replacement.

This leak testing procedure has been publicised by the LPG Association⁽²⁵⁾ and is included in a label on all new cylinders, and is included in instructions supplied with heater appliances, but with all this, the practice is rarely used.

I consider there would be strong encouragement to undertake regular leak testing if all new heater appliances and new cylinders were provided with a plastic bottle containing a soapy water solution, and clipped to the appliance such that it was readily accessible whenever a connection was made. I made this suggestion to Peter Jackson, Merchandise Manager, TheWarehouse, who sees no problem with this suggestion as it would be of minimal cost to make this an additional supply item.

I also consider that if all filling stations had these soapy water bottles available and offered them at each cylinder refill, then the consumer would be encouraged to test for a leak when connecting the cylinder to the appliance regulator.

For people concerned about getting some soapy water on their carpets, use of an absorbent cloth would overcome the problem.

- (b) **Mandatory Audit of all Indoor LPG Cylinder Use**
The option of an audit of all indoor LPG cylinder use, if practicable, would pick up many of the misuse of appliances and wrong connections incidents. However, I consider that it would be difficult, if not impractical to enforce. Apart from the census information (5) there is no database of domestic residents who use indoor LPG cylinders. With some 400,000 households and 500,000 mobile LPH heater appliances, the task to undertake an audit of each residence would be very time consuming.

To be useful, the audit would need to inspect the appliance in use and therefore, be undertaken during the winter. I estimate that the cost based on one hour inspection for each household at \$30 per visit, is \$12M plus overheads and disbursements.

4.2.6 Code of Practice

- (a) **Code of Practice for Indoor of LPG Cylinders and Appliances**
NZ does not have a Code of Practice for the use of LPG Cylinders indoors. There are good examples where such codes have a significant impact on the safety of operations in other sectors of consumer activities and are used as a means of compliance with the Regulations and Acts. There are skilled and knowledgeable people in

NZ in the LPG industry and Government Agencies who could together produce such a code which would be the basic guideline for good practice. The code could refer to all relevant standards and design specifications, and be modeled on the UK LPG Codes of Practice such as Code of Practice 15 "Valves and Fittings for LPG Service".

This option is discussed further in Section 6.2.

(b) Create a NZ Standard for Indoor Use of LPG Cylinders and Appliances

Although there is no NZ Standard for this particular application, there are overseas standards which NZ can align to or adopt in part which could meet the requirements. However, NZ is not a leader in the manufacture of the various components in the cylinder to appliance train, and to produce a Standard might not be cost effective or lead to a reduction in incidents. There is no problem over the quality of components being imported into NZ as the approval process can specify the manufacturing and inspection standards, but how these components are assembled to meet a particular need is one of the major problems.

There is the ANSI Z21.81 1997 and CSA 6.25-M97 Standard for "Cylinder Connection Devices" which could serve as a useful basis for developing a NZ Standard.

There is also the AS/NZS 1596:2002 "The Storage and handling of LP Gas"

Standard which ERMA could approve to meet the requirements regulating quantities of LPG able to be stored inside domestic and light commercial premises.

4.2.7 Review Enforcement Processes

In my opinion, there appears to be a lack of direct feedback within the enforcement agency OSH, ESS, and the NZ Fire Service, which would mean that results and recommendations arising from investigations of incidents and accidents could be immediately actioned in the approvals process. This topic is discussed further in Section 6.

5. Preferred Connection System

In order to avoid the possibility of wrong assemblies of components being made in the cylinder to appliance connection, it would be preferable to have one approved connection system.

This is the case in the UK and it is helped by having ownership of the cylinders and valves in the hands of specific companies set up to supply the filled cylinders(26). However, it is not the case in Ireland where there are two approved systems for indoor butane cylinder use, and one for the propane cylinder use.

In NZ, the evolution of various fittings has arrived at the point where I consider there are three systems which represent safe use for indoor appliances.

- (a) The QCC system, although originally designed for North American BBQ and grill applications (outdoor use), has features built in to the valve and regulator assembly to ensure that it is also a safe system for indoor use. The video which ESS has on the Marshall-Sherwood Quick Closing Coupling Q.C.C.1(27) illustrates the various features which were required to be part of a safe connection system by the USA and Canadian Standards authorities. The manufacturers added several more.
- (b) The clip on connector is the European system and is widely used in Asian countries (28). Because this system has the seals downstream of the regulator, any leakage is from the low pressure side. The Kosan Compact Combi self closing cylinder valve has been approved for use in NZ and claims include easier fitting of clip on regulator than other valves, higher capacity throughput than for QCC, and improved safety because of two valves (one on the valve and one on the regulator).
- (c) The POL valve and fittings. This system is more suited to industrial and commercial use because the connection system requires a spanner and the fittings allow larger gas flows than for the QCC and clip on systems.

The heater appliances currently being imported into or made in NZ can be fitted to match all three systems.

In this discussion, the one system approach is restricted to the domestic and light commercial use of LPG cylinders for indoor appliances. These appliances are mobile heaters, and stove tops/hobs.

Where the 4kg, 4.5kg and 9kg cylinders are used for trades operations, such as by roofing contractors, the POL fittings are likely to be retained because they allow a greater flow of gas than the current QCC valve/regulator.

I acknowledge that other gas cylinder uses such as for medical use, and the larger 45kg LPG cylinders, use POL fittings and ownership of the cylinders and valves remain with the specialist company for the supply of the gas.

Manufacturers of the QCC fittings are not restricted to the USA and Canada, but include Thailand. This provides consumers with competitive supplies and ensures that any ongoing improvements and modifications can be assessed and approved for NZ as required.

For instance, if NZ chooses to require a modification to the QCC valve which will prevent POL fittings being screwed into it, I have corresponded with two manufacturers who say this can be achieved for the NZ market. The question as to delivery is dependent on order size, and whether UL approval will be required by the NZ approval agency.

I note the SCG Manufacturing Facility in Thailand is an UL approved manufacturing facility as reported by RSM Consultants Ltd on 19 October 1999 to OSH(29). SCG manufacture QCC valves and these are approved for use in NZ by OSH.

- 5.3 From a safety viewpoint, the BBQ and grill scene in NZ would also benefit from having a single connection system the same as for the indoor LPG cylinder use. Many consumers swap their cylinders between summer and winter use so if QCC was used indoors, it makes sense to have the same system for the BBQ. Moreover, the safeguards built in to the QCC system were specifically designed initially for the BBQ use, but similar safeguards are in place for the clip on systems.

Where very large BBQ's require gas flows greater than the QCC system will allow, ABER have advised that it would be possible to obtain a QCC regulator fitting that has a modified excess flow restrictor to meet larger flows(30). This connection would need to be identified in such a way as to not be confused with the normal indoor fitting.

- 5.4 There are reports from some of the cylinder testing stations of faulty nuts on the QCC regulator connection probe. The original nut was a plastic material that showed evidence of cracking and failing to tighten the connection. In some cases the connection has failed because of this fault, and should it occur, there is no escape of gas because the back check module function does not allow gas to pass unless the connection is positive. However, ESS have evidence that this is not always the case and leakage of gas has occurred with fractured nuts.

A preferred nut material is nylon and this has proved to be suitable in NZ. In a recommended system, such as a Code of Practice, such a nut would be specified for use.

5.5 Other improvements to the QCC system have been identified by ABER(30) and these would also be specified in a preferred connection system. It is noted that as a result of the IRL Investigation and Report(19), several QCC manufacturers have modified their designs and componentry and I believe the new products would meet David Firth's criticisms.

5.6 Conclusion

Although a one connection system would be easier to administer and enforce, I consider that using the QCC valve and QCC fitting, the Kosan valve (Compact valve) and clip on, and the POL valves as options is practical as long as the systems are not interconnected. Of the three systems, the QCC is the easier system to use for most domestic indoor use, both QCC and the Kosan systems have similar safety features, and the POL system has an advantage with larger gas flows.

6. Controls under HSNO Legislation

6.1 Transfer of Controls from Dangerous Goods Regulations to Compressed Gas Regulations

Under the proposed new Compressed Gas Regulations due to come into effect 1 April 2004, MfE and ERMA(31) have said that in respect of the requirements for the indoor use of LPG cylinders, the Compressed Gas Regulations will not be prescriptive. I understand that to accommodate the special requirements for LPG, the intention is to Transfer Controls via the Gazetting process as this will be a more flexible method of keeping up to date with improvements to safety and performance than relying on the Regulations themselves. There is uncertainty as to the timing for gazetting of controls and the extent of these controls.

Gas Appliances are outside the scope of the Compressed Gas Regulations. The Gas Regulations 1993 provide controls for gas appliances. The Gas Regulations are adopted as HSNO controls under s.57 of the Hazardous Substances (Class 1-5 Controls) Regulations 2002.

6.2 Aligning the Approval Process with Investigation and Reporting

Peter Williamson has identified a concern that he has with the existing method of approvals which is currently carried out by OSH (as an ERMA delegated Authority under Section 161 of the Hazardous Substances and New Organisms Act 1996) and the investigation and reporting of incidents which lies with ESS under the Gas Act 1992.

The existing Dangerous Goods Regulations and those proposed for the Compressed Gases under the HSNO Legislation do not, in my opinion, meet the requirements to overcome the problems that have been experienced to date in the use of LPG cylinders indoors.

The OSH approval process has allowed a number of approved fittings to be marketed in NZ but there is no direct feedback to OSH of problems experienced in the indoor use of LPG cylinders and with domestic users. For instance, the problems with cracking of the plastic nut in the QCC fitting has been known in the cylinder testing laboratories for some time(15) but Kim Comben was unaware of this problem(32). Similarly, the problem with the use of POL filling probes in QCC valves, and POL connections in general, has been known in the industry for some years, but this has not either been known or acted upon in regard to corrective action by OSH.

6.3 It seems to me that whoever is responsible for the issuing of approvals must know the appropriate design, manufacturing, pre-commissioning and periodic testing requirements to be met, and if there was a direct link with the reporting of incidents, then timely intervention could occur. ESS's database of incidents contains many references to technical and operational problems which have led to fires, injury and death from such events as leaking valves and fittings, and misuse of equipment.

Clearly, there was feedback in 1994 when the Rix valve was found to be faulty, and it was recalled. However, although problems with the QCC valves were reported in the late 1990's, there appears to have been no corrective action taken to avert the problems such as with POL fittings in the QCC valves.

6.4 Code of Practice

There is no New Zealand Code of Practice covering the use of LPG cylinders indoors. There are overseas examples that could be used as a basis for preparation of a NZ Code. Examples include:

- United Kingdom: LP Gas Association Codes of Practice 15 & 24
- United Kingdom: LP Gas Association Guidance Note GN2:2002

The LPG industry through the LPGA has already prepared a Code of Practice for the use of 45kg LPG cylinders which is being considered for approval by ERMA. It is suggested that the LPGA might be well positioned to prepare a new Code of Practice for the indoor use of LPG cylinders, specifically for the 4kg, 4.5kg and 9kg cylinders, with assistance from ESS and OSH. MfE funding through the Sustainable Management Fund (SMF) route may be applicable. Some industry sources have already offered to assist in this code preparation(25).

A Code of Practice specifically for LPG Cylinders and Appliances for Indoor Use could include sections on:

- contractual responsibilities
- applicable Standards
- materials
- specific design and construction features
- type testing
- production, setting and testing
- marking and packaging
- instructions for use
- filling of cylinders
- allowable assembly and connection systems
- storage quantities of LPG indoors
- compatibility in respect of fittings and connections

6.5 Guide to Gas Cylinders

OSH has prepared a document titled "Guide to Gas Cylinders" which was last issued in 1992. This document is now out of date and does not include all the technical and institutional knowledge which has accumulated since 1992, much of which resides with individuals within OSH. With regard to the indoor use of LPG cylinders, this Guide is a useful adjunct to the proposed new Code of Practice. Peter Williamson has recommended that this guide be updated and reissued as it would be a necessary document for the test certifiers under the Compressed Gas Regulations.

In my opinion, the qualifications that a test certifier should have include a tertiary mechanical engineering qualification, with experience in high pressure gas. The aspects of the valves which IRL has identified as being suspect, could be evaluated and assessed by a mechanical engineer and appropriate feedback given to suppliers and agents for the components in question.

6.6 Reference to Appropriate Standards

There is no ERMA approved NZ Standard covering the use of LPG cylinders indoors. There are numerous overseas standards parts of which NZ could adopt in the interests of expediency and cost reduction.

The proposed new Code of Practice could cite appropriate Standards for cylinders and fittings as a means of compliance with the HSNO Act and Compressed Gas Regulations. Some applicable Standards include:

- AS/NZS 1596:2002 The Storage and Handling of LP Gas
- BS EN 449:2002 Specification for dedicated liquefied petroleum gas appliances-domestic flueless space heaters
- NFPA 58:2001 Liquefied Petroleum Gas Code
- ANSI Z21.81-1997 Cylinder Connection Devices

6.7 Storage Quantities of LPG indoors in domestic situations.

There has been concern expressed by the NZ Fire Service, ESS and OSH that there is no clear guideline to the quantity of LPG able to be stored indoors in domestic residences. LPG cylinders can be hooked up to mobile heaters and separately to hobs and stove tops.

Under the Dangerous Goods Regulations, the limit was 10kg. It is conceivable to have two mobile LPG heaters each with a 9kg cylinder and a 9kg cylinder under a stove/hob all in one residence, and maybe a spare filled cylinder.

Under AS/NZS 1596 Table 2.1 Minor Storage, the storage limit is 25L for residential buildings of any type and for restaurants in NZ.

Clearly this situation needs to be resolved, not only for domestic residences, but also for restaurants and commercial premises.

7. International Comparisons

7.1 United Kingdom

7.1.1 The LP Gas Association(26) gave the following information in response to questions that I asked of them:

- (a) The cylinder sizes for use in the indoor LPG heater scene are 7kg and 15kg cylinders. The connection system is the clip on with both 20mm and 21mm options.
- (b) The cylinders are tested at 15 yearly intervals by competent persons soon to be changed to Government appointed Inspection Bodies, but the people will be the same.
- (c) The valves are replaced at the cylinder inspection irrespective of condition.
- (d) The regulator and hose are recommended to be replaced every 5 to 10 years but there is no compulsion.
- (e) Servicing of the heater appliance is recommended to be done annually but there is no requirement to do so.
- (f) The cylinder is owned by specialist filling companies and the consumer does not own the cylinder, supposedly because of the practicalities and regulatory/supervision duties.
- (g) The heater appliance is subject to the CE marking under the EU Gas Appliances Directive which includes type examination and quality assurance. Cylinders and valves are subject to design approval by Government and then statutory QA and in service inspection (the regime is changing due to implementation of the EU Transportable Pressure Equipment Regulations and the implementation of the ADR Transport Regulations).
- (h) Regulators and hoses are not covered by any statutory regime and there are long established British Standards for hose and regulators (BS3212 and BS3016 although 3016 is being superseded in this application by the European Standard EN12864).

7.1.2 Health and Safety Executive

The HSE have a web page which provides statistics on Gas Safety in the United Kingdom. The latest information available through this source (33) of Incidents relating to Supply and Use of Flammable Gas since 1986/1987 is listed under categories:

- Number of Incidents
- Number of Fatalities
- Number of Non-Fatalities
- and for each, whether the incident was an Explosion/Fire or CO Poisoning.

Since 1986, the total number of incidents per year has been consistent varying from a minimum of 116 in 2002/2003 to a maximum of 179 in 1993/1994, with a mean of 146 per year.

The total number of explosion/fire incidents per year has varied from a minimum of 30 in 2002/2003 to a maximum of 71 in 1987/1988, with a mean of 46 per year.

I have asked the HSE for a break down of this information, specifically, the number of mobile LPG Heater incidents
the number of households with bottled LPG,
what is the trigger for reporting the incident, and who prepares the report.

As at the time of writing this report, I have not had a response to this request, and this is critical to a better understanding of the statistics for comparing the safety performance between the UK and NZ.

7.1.3 Comment:

The average number of incidents per year for explosion/fire in the UK (46) appears to be similar to the total number per year recorded in the ESS database (between 30 to 50). I would expect the number of households in the UK that have bottled gas may well exceed 1,000,000, i.e. some 3 times greater than in NZ (350,000) but I do not know what the actual numbers are. Jim Green (ESS) expects the numbers of households in the UK which have mobile bottled LPG heaters to be substantially less per 100,000 households compared with NZ and the incident rate may be similar.

It would be necessary to get better information from the UK, before comparing the incident risks as between the two countries.

7.2 Australia

7.2.1 The Australian Regulations do not allow mobile LPG heaters to be used indoors, and instead encourage the use of fixed flued heaters or portable heaters which can be connected by hose and bayonet connections to a piped LPG distribution system connected to a 45kg LPG cylinder. These reticulation systems require certified gas fitters to install them under the Gas Installation Code AS5601.

7.2.2 There is no restriction on the installation of 4.5kg cylinders to fixed appliances like stove tops and hobs.

7.2.3 Commercial kitchens and restaurants do use LPG cylinders for mobile woks and the like, and in these cases the government agencies try to restrict the cylinder size to 4.5kg. Portable appliances (using bayonet fittings to a piped gas supply) are not restricted.

7.2.4 Because the use of mobile LPG heater appliances is not allowed in Australia, there is no Code of Practice applicable to this equipment.

- 7.2.5 The quantity of LPG able to be stored indoors is limited to 12 litres (6kg) for domestic and residential premises under AS 5601.

In relation to ventilation requirements for unflued gas heaters, SouthAustralia has ruled :

the maximum size of unflued heater capacity is 18 megajoules per hour (5kW) for natural gas and LPG(34).

The actual size of heater is limited in accordance with the formula:

- (a) Non-Thermostat Model
maximum megajoule rating = room volume in cubic metres x 0.2
- (b) Thermostat controlled Model
maximum megajoule rating = room volume in cubic metres x 0.4

- 7.2.7 Ventilation in the room must be provided at the rate of 10 square centimeters at both high and low levels, per megajoule per hour (0.2777kW) of the heater.

- 7.2.8 Comment

The above ventilation requirements are perhaps a useful guide when considering ventilation requirements for unflued gas heaters (including mobile LPG heaters) in New Zealand.

- 7.3 United States of America

I understand that in the USA the QCC system has been mandated for use outdoors for BBQ and grills. It has not been approved for use indoors with mobile LPG heaters because these appliances are not allowed.

I have not obtained any information on the problems experienced with QCC systems in the USA and this is one aspect that could be followed up. I expect that any significant problems with leakages in the seals would be addressed as they arose because of the large market for these systems in the USA. Although the QCC valve has provision for POL fittings, i do not know if this has been a problem in the USA.

- 7.4 Ireland

- 7.4.1 Indoor Use of LPG

Ireland uses Butane and Propane cylinders for domestic indoor use(35) and their requirements are:

Butane cylinders may be used indoors for mobile LPG heaters and stoves provided

- (a) the cylinder valves are self-closing
- (b) the capacity of the cylinder is not greater than 15kg
- (c) the number of cylinders is kept to a minimum
- (d) the cylinders are well ventilated and NOT below ground level

Propane cylinders should never be kept or used indoors in domestic premises.

In regard to the type of fittings on cylinders, the butane cylinders are available in three cylinder types:

- Flogas Butane-yellow cylinder with Butane Jumbo valve and clip on Jumbo low pressure regulator
- Ergas Butane-orange cylinder with Butane Jumbo valve and clip on Jumbo regulator
- Ergas Butane-blue/green cylinder with Butane Compact valve and Compact clip on regulator.

The butane cylinders with the different types of valves and regulator fittings are not inter-connected. The cylinders are supplied in 4.5kg, 5kg and 11.34kg capacities.

The propane cylinders have the screw thread valves and regulator fittings (POL) and are supplied in capacities 3.9, 10.9, 12, 13.18, 18, 19, 34, 47 kg and 290litre..

However, there has been a recent addition to the range of cylinders and "Patio Gas" is supplied in black 11kg cylinders containing propane, but with a Jumbo compact valve and Jumbo clip on regulator fitting, which makes it able to be used for BBQs as well as patio heaters.

Comment: The Irish situation allows two different valve and regulator fittings for butane cylinders for indoor domestic use, and a separate POL valve and fitting for propane cylinders for non-domestic and outdoor use.

8. Other Domestic Uses for 9kg LPG Cylinders

8.1 Patio Heaters

Patio Heaters incorporate the 9kg LPG cylinder within the structure of the base support. These heaters are purchased for the domestic consumer as well as for restaurants and public areas and the units are mostly located outdoors but can be within alcoves or interior spaces that open to outdoors.

In NZ the heaters use connection systems that can be any of the current variety for domestic appliance use and therefore, there is the possibility of connecting non-QCC regulators probes to QCC cylinder valves.

The patio heater market is expanding although the current numbers in use in NZ is not known but assumed by the LPGA(3) to be about 50,000.

There is the potential for fires arising from leakage of LPG from the cylinder connection and therefore, any method to prevent wrongful connections will reduce this possibility.

There is a concern expressed by Local Authority inspectors about the advent of patio heaters and the increased quantities of LPG being stored inside in 9kg cylinders. NZ does not have clear guidelines on the storage of LPG indoors for domestic and light commercial premises, and this needs immediate attention.

8.2 BBQ and Grills

The LPGA estimate(9) that there are in excess of 1,000,000 9kg cylinders in use in NZ and most of these will be associated with BBQs, grills, and mobile heaters in domestic residences. In 1999 there were 100,953 new 9kg cylinder sales, 20,796 2kg to 3kg cylinder, and 21,243 4kg to 5kg cylinder sales.

Because a consumer may own both a BBQ and a mobile heater, it would make interchangeability of cylinders much easier if all appliances had the same compatible cylinder connections. In some instances, because a BBQ is mainly used in the summer, whereas the mobile heater is used in the winter, an owner may use the one cylinder for both appliances. If the connector for say the BBQ is not a QCC fitting whereas the mobile heater has a QCC fitting, there is the possibility that the QCC cylinder valve will be damaged by the non-QCC BBQ regulator fitting, and this may cause a leak and a fire indoors when the heater is in use.

8.3 Stove Tops and Hobs

ESS has analysed the NZ census data from 1996 and 2001 and has concluded that there were 118,000 households that used LPG cooking in New Zealand in 2001, compared with 361,000 households that had mobile LPG heaters. On this basis, there are approximately one third as many LPG cylinders used for cooking as for mobile heaters.

Comparing the rate of incidents as between mobile LPG heaters and LPG cooking, the LPG heaters had a higher rate of 12.3 incidents per 100,000 households than for LPG cooking at 6.3. However, the incident rates were similar for more serious incidents at 1.7 reportable incidents per 100,000 households for both uses of LPG.

It would certainly help if all the connections in a household were of the one system type as many of the incidents could be caused by leakages arising from POL fittings screwed into QCC valves.

9. Conclusions and Recommendations

Databases

- 9.1 Within the last 10 years, NZ has seen a regular number of incidents involving LPG cylinders indoors giving rise to fires, injury, death, and structural damage. These incidents appear throughout NZ and number some 40 to 50 per year. There have been 6 deaths as a result of fires.
- 9.2 The reasons for this spate of incidents can be grouped into four categories:
- 50% arise because of a leakage in the cylinder connection system
 - 25% arise out of misuse by the consumer of the appliance and LPG system
 - 5% arise because of cylinder overfills
 - 20% are of unknown origin

The various databases from which this information on incidents is recorded are kept by ESS, the NZ Fire Service and ERMA. However, no one database has a complete record of incidents involving indoor use of LPG cylinders. Under the Gas Act 1992, ESS is responsible for investigating notifiable incidents. The current databases that I reviewed, namely, ESS, NZ Fire Service and ERMA, appear to have gaps and are not easily interrogated to find, for example, all mobile LPG heater incidents, or all LPG stove/cook top incidents.

In many of the incident reports, the person attending the incident was not qualified to say which component was at fault and a general statement was filed "no known cause" or "part failure, leak or break". It would be worth having an expert opinion as to the cause so that the incident may not be repeated. The NZ Fire Service should be required to call on such expert opinion before filing their reports if this is not the current practice.

I believe that there should be one complete database for incidents involving indoor use of LPG cylinders and this could be compiled from the three known databases. Each of the existing database should continue because each serves a different function.

Recommendation 1

THAT there should be one reliable database of incidents for indoor use of LPG cylinders compiled from the ESS, NZ Fire Service and ERMA databases. These three existing databases should continue to provide the functions for which they were created.

Code of Practice

- 9.3 New Zealand does not have a Code of Practice for the use of LPG cylinders indoors and I believe that most of the issues relating to specifications for assemblies, misuse of connections and filling systems could be addressed if such a code was in existence. There is precedence for the LPGA to produce such a code as they have completed one for use of 45kg cylinders. The LP Gas Associations codes in the UK, specifically Nos 15 & 24, and Guidance Note GN2:2002, are examples of appropriate codes. The Code of Practice to include the items listed in sub-section 6.4 of this report.

Recommendation 2

THAT a Code of Practice for Indoor Domestic Use of LPG cylinders be prepared and approved by ERMA.

Connection Systems

- 9.4 Within NZ there are many different connection systems in use for the 9kg and smaller LPG cylinders. The various components within these systems have been approved by OSH and except for the most recent approvals, they were approved without a requirement for renewal of certification. There have been recalls of certain products when these have proved faulty.
- 9.5 The reason for much of the leakage observed in the connection systems has arisen through damage caused to the seals within the valves when connections are made of a non compatible type. For instance, when a POL filling nozzle is used on a QCC valve, or a POL regulator probe is screwed into a QCC valve, the face seal and the back check module seal can be damaged, and also the back check module can become jammed or unscrewed when the fitting is removed.

There are QCC valves of recent manufacture where a circlip or restraint is inserted to prevent the back check module from unscrewing and there have not been any reported leakages from these valves because of damage to the back check module.

Leakage has been observed with all the connector systems such as leakage around the handwheel stem, damage to elastomeric seals and O rings, and damage to the metal mating surfaces.

- 9.6 The connection system that has been developed for the BBQs and grills in North America is termed the QCC system and this system is favoured by a substantial number of the heater appliance suppliers in NZ. It has safety features, which although originally designed for outdoor use (BBQ and grill), have been recently

improved and, I believe, make it suitable for indoor use. Only the Compact valve and clip on system has comparable safety features.

- 9.7 Cylinders currently supplied new in NZ can have a QCC valve that allows a POL connection to be fitted. I propose that this be discontinued as there have been many problems with this type of fitting, and a remedy would be to fit a QCC valve that does not allow a POL fitting to be connected.
- 9.8 The result of this change is that the appliance industry still has a choice over the type of fitting supplied, but the cylinders will have valves that accept only QCC. or clip on or POL fittings. A consumer purchasing a cylinder will need to determine which connection system is required for the appliance.
- If a consumer needs to replace the cylinder valve, the cost for a new QCC OPD valve without POL screw thread is estimated by ABER to be \$28.
- 9.9 If cylinder QCC valves are mandated to be QCC only, then there needs to be a process by which all consumers with other connections can have their fittings changed. I have been advised by ABER that the cost of changing the POL regulator probe fitting to the QCC probe is approximately \$10 for the parts.
- 9.10 The oldest QCC valves that were introduced in 1994, are the ones which have identified problems, and need to be replaced. This replacement could take place at the time of the 10 year cylinder test, which would start to occur in 2004 and go on for a number of years. I do not know how long these valves were available for sale before the more acceptable designs came onto the market.

Recommendation 3

THAT a new QCC OPD valve, without the POL screw, be approved for use in NZ. The specification for this valve to include the design features now considered acceptable for NZ use.

Recommendation 4

THAT all the old style QCC valves, which have identified problems, be recalled and replaced with the new QCC OPD valve. Existing QCC valves of good design, but still with the POL internal screw, to be left in service.

The Storage and Handling of LP Gas

- 9.11 There is no ERMA approved NZ Standard for the Storage and Handling of LP gas and this presents a problem when it comes to ruling on allowable quantities of LPG to be stored inside domestic and light commercial premises. The case in point is the increase in patio heater use and the number of 9kg LPG cylinders that could be stored indoors in domestic and light commercial premises.

There is the AS/NZS1596:2002 Standard which meets this requirement in part and I propose that this standard be amended to consider storage of LPG in domestic and light commercial premises, if need be, and then approved by ERMA.

Recommendation 5

THAT AS/NZS 1596:2002 " The Storage and Handling of LP Gas" be reviewed and approved by ERMA for use in New Zealand.

Cylinder Testing Laboratories to Include for Valves

- 9.12 The cylinder testing laboratories currently undertake replacements of valves but they are not equipped to test the valves in an approved rig. If each laboratory had this facility, then a customer could bring their cylinder and valve, and appliance regulator for servicing, or replacement of faulty connections and hoses and get a certificate of fitness if this was deemed appropriate. Such a provision might encourage insurance companies to insert this as a qualifying clause in householders' policies for cover in case of fire.
- 9.13 The cylinder testing laboratories would be appropriate to carry out the replacement programme for old QCC valves and other valves and the installation of the proposed new QCC OPD valve.
- 9.14 Whether it is more economic for the consumer to get a valve replaced rather than tested is something which will become evident once all the costs are determined.

Recommendation 6

THAT all cylinder testing stations be equipped with facilities to test and service valves.

- 9.15 I do not think it is necessary to get all valves, regulator probes and regulators replaced at specified periods if the equipment is used with compatible fittings. It may only be necessary to replace seals. Testing of valves at the manufacturers

facilities (ANSI Z21.81-1997) call for tests involving 10,000 operations of the valve connection and disconnection without fail (see section 2.7 Endurance Test sub-section 2.7.2) and this clearly is in excess of usage in domestic applications.

As a minimum, I suggest that all cylinder valves be tested every 10 years and it would be appropriate if this occurred at the 10 year cylinder test.

The appropriate test would be to have the supply side of the cylinder portion connected to a source of aerostatic pressure maintained at 690kPa and secured to a test stand, with the mating appliance portion is closed or blocked, and test for leaks at the seals and around the assembly.

I note that the UK replaces the cylinder valves every 15 years, and that could also be an option for NZ, but maybe at every 10 years to coincide with the cylinder test.

Recommendation 7

THAT all cylinder valves be tested or replaced (if that is the cheaper option) at the same time as the 10 year cylinder test.

Cylinder Filling

- 9.16 Much of the cylinder testing station reported damage to valves is caused by the use of POL filling nozzles at the petrol station forecourts. Although site certifiers are trained to avoid this problem in the LPG Training programme, this is not always transferred to the filling operator. The POL filling nozzle has considerable leverage which can damage the internals of the QCC valve, specifically the regulator bullnose face seal, and although filling stations are offered a QCC adaptor for the nozzle(25), not all filling stations have them or use them. It appears that the POL nozzle is still used in the interests of speed when the forecourts are busy.

Having a QCC only valve without the POL internal screw thread, would overcome this problem. However, the filling operator needs to also check for cylinder validity, and for damage to valves which is part of the training requirements for approved fillers.

- 9.17 I understand that the Compressed Gas Regulations will say that the person charging the compressed gas container with compressed gas must be either:
- (a) an approved filler or
 - (b) an approved filler is present at the location where containers are being filled, and has provided guidance to the person filling the container and is available at all times to provide assistance.

I do not consider that in the instance of filling 4,5kg and 9kg LPG cylinders, (b) is adequate and I propose that this be deleted from the Regulations.

I do not believe that strengthening the enforcement of supervision of the forecourt operator will meet all the problems at the forecourt. One concern is the recognition of damaged seals and valve components, which I believe an approved filler will be capable of undertaking, but will not be picked up by having an on-site supervisor who could be anywhere but on the forecourt.

- 9.18 I have noted from the database information that there have been some 5% of all incidents caused by overfilling of the cylinder. All new cylinders since April 2003 have the OPD valve fitted so overfilling should not occur with these cylinders, but the old stock continue to be filled by weight. Again, better training and supervision of the forecourt operators would address this problem, and an approved filler would certainly meet this requirement.

The training and certification of approved fillers would be an ongoing process and similar to the LPGA programme for site certifiers.

Recommendation 8

THAT all LPG cylinder filling station operators be approved fillers.

Leak Testing

- 9.19 Apart from a general publicity campaign to get people to be aware of the need to regularly service equipment, to not put heaters in bedrooms, and to avoid putting clothes too close to the heater, the greatest assistance which people can avail themselves of is to undertake regular leak testing.

My suggestion here is for the appliance retailers and the filling stations to have a free supply of leak testing containers, such as a polyethylene bottle with a dispensing nozzle filled with a soap solution, which users can have readily at hand at the appliance and at the cylinder. If leak testing became a practice or habit whenever new connections are made prior to using the appliance, then this alone could prevent many of the incidents as the user would be warned not to light the appliance if a leak was observed.

A persistent leak would be an indication that servicing of the equipment was necessary and replacement of parts.

Recommendation 9

THAT all retail outlets for cylinders and appliances be required to issue soapy water leak testing bottles and instructions, with all new equipment purchased, and filling stations be required to offer soapy water leak testing bottles and instructions, with each cylinder refill.

HSNO Act and Controls

9.20 The regulations controlling the use of LPG under the HSNO Act will be incorporated into the Compressed Gas Regulations due to be issued in 2004.

These regulations essentially transfer the controls that were in the Dangerous Goods Regulations but require ERMA to be responsible for all controls under the new Act.

In discussion with ERMA and MfE, it is clear that all the controls required for the indoor use of LPG cylinders will not be specified in the Compressed Gas Regulations, and instead, a process of gazetting the transfer of controls will take place. There is no clear programme of what is to be included in the transfer of controls, nor of the timetable, but I understand that the gazetting process will allow a consistent approach to introduction of the recommendations in this report.

Recommendation 10

THAT ERMA introduce controls for the above recommendations through the gazetting process once the Compressed Gas Regulations are introduced.

Misuse of Appliances and LPG System

9.21 One of the most significant causes of the incidents recorded in the various databases is the misuse of equipment by people in the domestic scene. I have noted that some 25% of incidents could be attributed to misuse of equipment.

Common among the observed problems are:

- putting inflammables (such as clothing) too near the heater
- not testing for leaks after making a connection or when using the appliance
- not carrying out regular servicing of the equipment
- not cleaning the heater gas jets, etc after heater storage
- making connections which are not compatible with the valve design
- putting the heater in bedrooms
- not having adequate ventilation in the room where the heater is being used

- turning the gas flow down using the cylinder valve instead of the appliance control valve
- not being aware of the maximum LPG indoor storage quantities

One of the consequences of not using the control valve at the heater appliance to turn down the heater is that the air/fuel flame characteristics are altered and the flame can produce carbon monoxide. CO poisoning is a major concern both in NZ and in the UK (see section 7.1) and the general public needs to be made aware of this. I am not aware of the extent of this problem in NZ but it has been identified.

Recommendation 11

THAT a publicity campaign be implemented prior to winter 2004 targeting all indoor mobile LPG heater users to highlight the need for leak testing, prevention of flammable clothing next to heaters, ventilation of heated rooms, correct control of heater, and banning heaters in bedrooms, maximum quantity of stored LPG indoors, and the need to replace QCC valves with identified problems.

Guide to Gas Cylinders

9.22 The approval processes for LPG gas cylinders and heater fittings have been reviewed by Peter Williamson(5) in his internal report of 11 December 2003. What is significant in this report is although the approval processes are deemed appropriate, because of the expertise and knowledge held by a few key people within OSH, there is a real danger this can be lost or not passed on to the new test certifiers.

The test certifiers will need substantial reference data to assist them in their duties and the best example is the Guide to Gas cylinders prepared by OSH. However, it is out of date and requires updating with the institutional data available within OSH.

I agree with the Peter Williamson recommendation that the OSH Guide to Gas cylinders be updated.

Recommendation 12

THAT the OSH "Guide to Gas Cylinder" document be updated and reissued for use by the test certifiers under the Compressed Gas Regulations.

System Approval

- 9.23 I am concerned that although individual components for the connections and fittings have been approved since 1985, there is little indication of a system approval. This means any of the approved fittings can be coupled together with appropriate approved adaptors but this has often given rise to damaged components and leakage because the combination has not been compatible.

I would prefer to see a system approval approach that also has a nominated period for re-approval. By system approval, I mean an assembly of components from the valve to the regulator. Because of improvements to valves and fittings brought about by continued research and in response to investigations of incidents, the approvals need to be for specific periods and requiring recertification to gain further approval.

Recommendation 13

THAT fittings approvals be specific as to the approved system to ensure compatibility, and that approvals be for a stated period until recertification.

Responsibility for Approvals

- 9.24 Peter Williamson identified a concern about responsibility of approvals for all the components including the LPG heaters. At present OSH approves the cylinders, valves and regulators whereas ESS are responsible for the appliance (heater) safety. As far as the mobile LPG heater situation is concerned, because it is a stand-alone unit, one approval process for all the components in the train makes sense, that is, the approval specifies the design requirements, manufacturing and testing requirements for all the components in the assembly. Whether this approval process can be undertaken by two or more test certifiers to the satisfaction of the industry needs to be evaluated. For simplicity, I suggest that one agency be responsible for the overall approval process, and if OSH is to continue in this role, then its powers need to be extended.

Recommendation 14

THAT there be one approval agency for all the components in the mobile LPG heater system.

Approvals and Reporting

- 9.25 There appears to be is no direct link between the enforcement agency responsible for approving the cylinder and fittings under the proposed Compressed Gas Regulations and the agency responsible for investigating notifiable incidents under the Gas Act 1992. In the past, there appears to have been a lack of response as between the investigative findings and the approval of existing and new componentry. I believe if this responsibility for follow-up response was given to one agency, say, the enforcement agency for approvals, there would be better feedback and timely action to mitigate problems. For instance, if design criteria need to be changed as a result of an investigation of an incident or number of incidents undertaken by ESS, there needs to be a process where an immediate response is put in place for corrective action by the approvals enforcement agency.
- 9.26 As I understand the Gas Act, under s.9 Special powers of Secretary, there is provision for the Secretary to do all such things as the Secretary considers necessary to remove or minimise the danger or potential danger. This applies to gas installations and gas appliances.

Under the proposed Compressed Gas Regulations, there is carry over from Dangerous Goods (Class 2-Gases) Regulations 1980 and there is overlap in the ability to impose controls in the area of gas installations and gas appliances.

Both appear to require a responsibility for fittings/appliances approvals and investigation of incidents without a clear indication of where the responsibilities fall.

Until the Compressed Gas Regulations are brought into force, I suggest that the enforcement agency for approvals of fittings and valves be required to respond to findings undertaken from investigations under the Gas Act 1992.

Recommendation 15

THAT the enforcement agency responsible for approving the components in the mobile LPG heater system be empowered to respond to the findings arising out of investigations undertaken under the Gas Act 1992.

Risk Assessment

- 9.27 I did not undertake a risk assessment to quantify the likely effect of each of the above recommendations, but I consider that it would be worthwhile to do so, especially when costs for implementing each recommendation are taken into account.

The risk assessment would need to quantify the level of uptake of each of the recommendations and so provide a total effect to test whether the improvement in risk reduction could achieve the target of 90% that I have stated as a desirable goal.

Recommendation 16

THAT a detailed risk assessment be undertaken to quantify the benefits and the costs specifically for Recommendation No 4.

Indoor Environment

- 9.28 My inquiry did not attempt to consider the impact of unflued heaters on the indoor air quality in domestic buildings. The proposed publicity campaign would address the issues of adequate ventilation and heater appliance maintenance to meet some of the air quality concerns. There are investigations underway by Phillipa Howden-Chapman at the Medical School, Wellington which are addressing these issues.

Implementation Timetable

- 9.29 I consider that all of the above recommendations can be initiated in 2004. The delay in getting design and UL approvals for the modified OPD QCC valve would be a time constraint in the implementation programme, but it may be possible to make the modification to a current UL approved valve without going through the process for new design approvals. The implications of this need to be assessed.

10. Summary of Recommendations

Recommendation 1

THAT there should be one reliable database of incidents for indoor use of LPG cylinders compiled from the ESS, NZ Fire Service and ERMA databases. These three databases should continue to provide the functions for which they were created.

Recommendation 2

THAT a Code of Practice for Indoor Domestic Use of LPG be prepared and approved by ERMA

Recommendation 3

THAT a new QCC OPD valve, without the POL screw, be approved for use in NZ. The specification for this valve to include the design features now considered acceptable for NZ use.

Recommendation 4

THAT all the old style QCC valves, which have identified problems, be recalled and replaced with the new QCC OPD valve. Existing QCC valves of good design, but still with the POL internal screw, to be left in service.

Recommendation 5

THAT AS/NZS 1596:2002 " The Storage and Handling of LP Gas" be reviewed and approved by ERMA for use in New Zealand.

Recommendation 6

THAT all cylinder testing stations be equipped with facilities to test and service valves.

Recommendation 7

THAT all cylinder valves be tested or replaced (if that is the cheaper option) at the same time as the 10 year cylinder test.

Recommendation 8

THAT all LPG cylinder filling station operators be approved fillers.

Recommendation 9

THAT all retail outlets for cylinders and appliances be required to issue soapy water leak testing bottles and instructions, with all new equipment purchased, and filling stations be required to offer soapy water leak testing bottles and instructions, with each cylinder refill.

Recommendation 10

THAT ERMA introduce controls for the above recommendations through the gazetting process once the Compressed Gas Regulations are introduced.

Recommendation 11

THAT a publicity campaign be implemented prior to winter 2004 targeting all indoor LPG cylinder users to highlight the need for leak testing, prevention of flammable clothing next to heaters, ventilation of heated rooms, correct control of the heater, and banning heaters in bedrooms, maximum quantity of stored LPG indoors, and the need to replace QCC valves with identified problems.

Recommendation 12

THAT the OSH "Guide to Gas Cylinder" document be updated and reissued for use by the test certifiers under the Compressed Gas Regulations.

Recommendation 13

THAT fittings approvals be specific as to the approved system to ensure compatibility, and that approvals be for a stated period until recertification.

Recommendation 14

THAT there be one approval agency for all the components in the mobile LPG heater system.

Recommendation 15

THAT the enforcement agency responsible for approving the components in the mobile LPG heater system be empowered to respond to the findings arising out of investigations undertaken under the Gas Act 1992.

Recommendation 16

THAT a detailed risk assessment be undertaken to quantify the benefits and the costs specifically for Recommendation No 4

References

- 1 Phillipa Howden-Chapman, Medical School, Wellington
- 2 Discussion at Rinnai office, Royal Oak, Auckland on 16 January 2003
- 3 ESS Data Base of LPG Incidents from 1975 to 2003
- 4 LPGA 1997 Annual Conference data provided by Peter Gilbert
- 5 ESS Draft internal report, "Bottled Gas (LPG) use in household heating and cooking" 2 Feb 2004
- 6 Peter Williamson, OSH "Review of Approval Processes for LPG Gas Cylinders and Heater Fittings", 11 December 2003
- 7 NZ Fire Service Data Base 02/07/1998 to 01/07/2003
- 8 ERMA Database
- 9 ABER Analysis of ESS Data 23/04/1992 to 13/06/1997
- 10 LPGA Data provided by Peter Gilbert on 22 December 2003
- 11 Tony Smith ESS internal memo 20 November 2003
- 12 ESS Draft internal report, "LPG Cabinet Heater Accidents" Feb 2004
- 13 Notes of visit to Ward's Cylinder Service Centre, Lower Hutt, 18 Dec 2003
- 14 Notes of visit to Tank Testing Laboratories, Manukau City on 16 Jan 2004
- 15 Notes of visit to Gas Fire and Cylinder Services, Tauranga on 19 Jan 2004
- 16 Gas Fire and Cylinder Report to CTLA 2003
- 17 Cylinder Testing Station Reports to OSH 2003
- 18 Cylinder Testing Station Reports to OSH Dec 2003/Jan 2004
- 19 IRL Report No 11395.01 "Examination of QCC Fittings", 19 June 2002
- 20 Tom Freeland, Manchester Tank correspondence 10 Feb 2004
- 21 David Lawson, Ceodeux Inc, Rotarex correspondence 4 Feb 2004
- 22 Alastair Pollock, OnGas telecom 2 Feb 2004

- 23 Discussion with John Lucas, Insurance Council of New Zealand (Inc) on 20 Jan 2004.
- 24 Peter Morfee, MED telecom 4 Feb 2004
- 25 LPGA "Gasline", August 2003 Issue
- 26 Jeff Watson, LP Gas Association, UK correspondence 27 Jan 2004
- 27 Marshall-Sherwood Quick Closing Coupling QCC1 Video
- 28 Tony Gregory, Rinnai New Zealand Ltd conversation 17 Feb 2004.
- 29 RSM Consultants Report No RSM1099001 "Independent Audit of SWG Manufacturing Facility, Thailand" 19 October 1999
- 30 Notes of visit to ABER, Te Rapa, on 19 Jan 2004
- 31 Meeting with ERMA and MfE in Wellington, 3 Feb 2004
- 32 Meeting with Kim Comben in Wellington, 4 Feb 2004
- 33 Health & Safety Executive, UK-web page
- 34 Office of the Technical Regulator, South Australia, bulletin 1464
- 35 Irish Gas, Ireland-web page
- 36 Kim Comben, Wellington 5 May 2004

Appendix A

Terms of Reference for an Enquiry into the use of LPG Cylinders in Indoor Situations (INQ03014)

Background:

Under section 11(e) of the HSNO Act the Authority may:

"Enquire into any incident or emergency involving a hazardous substance or new organism."

By establishing an enquiry the authority can use the powers under section 24 of the Act to request information relating to the incident (if necessary).

This enquiry will be focussed on the use of LPG in the indoor domestic environment. This has been triggered by a number of incidents involving LPG of which the Hastings incident is the most recent and severe.

The Energy Safety Service (ESS) is conducting an investigation under the Gas Act into the fire at Hastings. This will be confined to the Hastings fire, whereas the ERMA enquiry will take a broader perspective on the use of LPG cylinders, particularly in indoor situations. The ERMA enquiry will therefore use the results of the ESS investigation and build on them.

The Police and Fire Service are also conducting their own enquiries, the Police on behalf of the Coroner, and the Fire Service assisting the Police. The ERMA enquiry will not interfere with the Coroner enquiry.

OSH is separately looking at the OSH processes involved when issuing approvals for cylinder fittings, and have offered to assist the enquiry by providing technical resource.

Purpose of the enquiry:

- To establish what has been happening in indoor fires caused by the use of LPG
- To establish how and why these incidents occurred
- To determine how further incidents can be prevented
- To identify lessons that can be applied to achieve more effective risk management of

LPG used in indoors situations (this may extend beyond fires to include such risks as asphyxiation etc).

Scope of the Enquiry:

The enquiry will cover the following issues:

- Whether the issues are related specifically to indoor use of LPG cylinders
- Risks and benefits of the QCC and other types of couplings, including the situations where the couplings are used
- Linkages with other New Zealand legislation
- Whether there is any common cause in these incidents and in particular the extent to which it is related to either or both of:
 - a. Inadequacies in regulatory decision making
 - b. Non compliance with the regulations
- To the extent that non-compliance is a cause, the extent to which the monitoring and enforcement regime, and/or public awareness activities, could be improved to reduce non-compliance.
- Whether the new regulatory regime will address issues found by the enquiry, including the test certification process, and relevant standards for fittings and cylinders and other aspects related to the use of LPG, including public awareness programmes.
- Some comparisons with international practice and legislation where appropriate.

Where necessary, in relation to any of the findings of the enquiry, the enquiry will involve the systematic examination of the Act, relevant regulations, the Authority's functions, and enforcement functions.

Process – Who:

The Authority will appoint a senior person, external to ERMA, to run the enquiry.

The Authority will engage an engineering consultant to advise on the technical aspects of the enquiry. The consultant will utilise and build on the work undertaken by OSH and ESS.

Coordination of the enquiry will be provided by the Operations Group of ERMA.

Process – What:

The final report will include recommendations indicating:

- Whether LPG should be restricted to particular use situations.
- Which aspects of risk management should be reviewed or adjusted.
- How this should be done and by whom.
- The financial costs and risks of the options.

Process – When:

The enquiry will start immediately, and will draw on the results of the ESS and other investigations. This will include particular issues regarding the QCC fittings.

The enquiry will be completed by mid-March 2004.