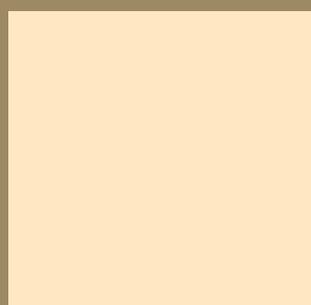
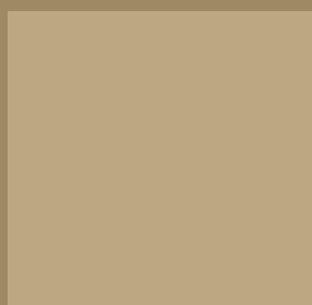


THE ICL INQUIRY



The ICL Inquiry Report

Explosion at Grovepark Mills, Maryhill, Glasgow
11 May 2004

Presented to the House of Commons and the Scottish Parliament under S26 Inquiries Act 2005

Presented to the House of Lords by Command of Her Majesty

Ordered by the House of Commons to be printed on
16 July 2009

Laid before the Scottish Parliament by the Scottish Ministers
July 2009

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The Secretary of State for Work and Pensions
The Cabinet Secretary for Justice

Dear Secretary of State and Cabinet Secretary,

In terms of my appointment dated 21 January 2008, I have held a public inquiry into the explosion that occurred on 11 May 2004 at Grovepark Mills, Maryhill, Glasgow.

I have the honour to submit to you my Report.

Brian Gill

Brian Gill
July 2009



Introduction by the Right Honourable Lord Gill, Chairman of the Inquiry

The tragedy that occurred at Grovepark Mills on 11 May 2004 has blighted the lives of many people. My purpose in this Inquiry has been to fulfill my Terms of Reference, which are set out below, and to make proposals for a new safety regime for LPG installations that will minimise the risk that such an event will be repeated.

Terms of Reference

- To inquire into the circumstances leading up to the incident on 11 May 2004 at the premises occupied by the ICL group of companies, Grovepark Mills, Maryhill, Glasgow.
- To consider the safety and related issues arising from such an inquiry, including the regulation of the activities at Grovepark Mills.
- To make recommendations in the light of the lessons identified from the causation and circumstances leading up to the incident.
- To report as soon as practicable.

This is the first joint inquiry to be held under the Inquiries Act 2005 (the 2005 Act) and the first to be conducted under the the Inquiries (Scotland) Rules 2007 (SSI 2007 No 560) (the 2007 Rules). The 2005 Act has introduced a new framework for public inquiries that will greatly increase the efficiency with which they are conducted without compromising the thoroughness of the process. The essence of this approach is that inquiries will be inquisitorial processes, in which the relevant questions will be determined by the inquiry, rather than the adversarial, litigation-based processes typical of major inquiries in the past in which the inquiry agenda has been set by the participants themselves. In this new approach, there is no reason to fear that the truth-finding process will be compromised. On the contrary, there is every reason to think that it will be enhanced.

I hope that this Inquiry has demonstrated the strengths of the new procedures.

Since this has been the first joint inquiry under the new procedures and since it has been the first of its kind to be held in Scotland, I have set out the history of the Inquiry in Appendix 4 to this Report. I hope that this history will be helpful to those who have to conduct similar inquiries of this kind.

I am grateful to the Inquiry Team who collected and analysed a mass of evidence quickly, organized the inquiry hearings efficiently and, above all, assisted the core participants at every stage.

I am grateful too to counsel to the Inquiry, both of them outstanding lawyers, for the benefit of their skill and experience; and to the core participants and their representatives for the help that they have given me in fulfilling my terms of reference.

Lastly, I am grateful to the staff of the Maryhill Community Central Hall for their unfailing help throughout the Inquiry hearings.

This was an avoidable tragedy. My Inquiry has examined its causes and considered how the risk of a similar tragedy can be minimised. I hope that my recommendations will put LPG safety on a new footing: But I am conscious that progress in LPG safety will have been achieved at great cost to the victims of this disaster and their families. I extend to the families of the deceased and to those who were injured my heartfelt sympathy.

Brian Gill
July 2009

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The deceased

Margaret Brownlie
Annette Doyle
Peter Ferguson
Thomas McAulay
James Stewart McColl

Tracey McErlane
Kenneth Murray
Timothy Smith
Ann Trench

The injured survivors

James Aitken
William Aitkenhead
Gordon Bell
Alan Byrne
Alan Donaldson
Nicholas Downie
Nicole Eaglesham
Stacey Eaglesham
Monica Flynn
Daniel Fraser
Andrew Galloway
William Gifford
Daniel Gilmour
David Hamilton
Martin Hamilton
Charlene Howarth
Derek King

Linda Kinnon
Archibald Lindsay
Elizabeth Logie
Sheena McColl (now O'Brien)
Christopher McGinley
James McGoldrick
Maureen McPhail
Claire McShane
William Masterton
Ian Mavers
Elizabeth Mills
Tammy Nelson
Christopher Provan
Charles Robertson
John Turner
Matthew Wylie

Those exposed to the risk of death or injury

James Anderson
David Andrews
James Baxter
William Chapman
Patrick Feggans
David Forde

Linda Johnston
Robert McMillan
Anthony Northcote
Joyce Russell
Jason Stewart
Robert Warren

Part 1

Chapter 1 – The explosion, the rescue operation and the victims

On Tuesday 11 May 2004, at about noon, an explosion occurred at Grovepark Mills, Maryhill, Glasgow which caused the substantial collapse of the former Mill building. As a result, 9 people lost their lives and 45 people were seriously injured or exposed to the risk of death or injury.

The premises at Grovepark Mills were owned by ICL Plastics Limited and occupied by ICL Technical Plastics Limited (ICL Tech) and Stockline Plastics Limited (Stockline), all of them

members of what I shall call the ICL Group. The ICL Group consists of seven privately owned limited companies. ICL Plastics is the holding company. ICL Tech and Stockline are two of the six operating subsidiaries. Most of the victims of this disaster were employees of one or more of these companies.

The Police, the Fire and Rescue Service and medical teams promptly arrived at the scene. By 12.15 pm, the police had set up a control point at the site. By 12.30 pm the Police



Figure 1 - Image copyright of HSE

Incident Commander had declared a Major Incident, had put in place arrangements for co-ordinating the rescue effort and had established security cordons. By 1.00 pm, the Southern General Hospital Mobile Medical Team was on site. Soon after, Assistant Firemaster William McDonagh took command of the rescue operation. At first, there were five fire crews. Fourteen more were called in. The medical teams established a triage procedure and had the injured taken to various hospitals in the Glasgow area. By mid-afternoon, twenty four casualties had been removed to hospital, sixteen persons were believed to be still buried in the rubble and the rescuers were in contact with five persons who were trapped. At 9 pm the last survivor was rescued. By the end of the day, there were thirty seven known casualties and six fatalities.

Hundreds of emergency service personnel from across the United Kingdom offered help, including the members of specialist rescue teams throughout Scotland and the north of England. Over the next three days the bodies of the deceased were recovered. The last was removed from the site at 11.25 am on 14 May. At the end of the rescue phase, the Fire and Rescue Service gave control of the scene to the Police.

The members of the emergency services who attended the scene showed outstanding professionalism and dedication. They worked tirelessly in difficult and harrowing circumstances. The staff of the nearby Community Central Hall in Maryhill provided support and refuge to the relatives and friends of the casualties in the difficult hours immediately after the disaster and throughout

the rescue operation. This was an occasion when ordinary people did extraordinary acts.

Chapter 2 – The cause of the explosion and its effects

The investigation established that the explosion was caused by the ignition of an explosive atmosphere that had formed in the basement area of the building.

The explosion produced high overpressures that caused the building to collapse more or less within its own footprint. The flat roof sections dropped almost directly downwards. The Hopehill Road end of the building collapsed almost completely. The Grovepark Street end was severely damaged but remained standing.

At the west gable end, where the despatch area faced onto the ICL car park, the stair tower collapsed entirely. Much of the east wall facing onto Gael's car park also collapsed. Most of the south wall that faced onto the main yard, and the north wall between the main building and the fabrication shop collapsed. The fabrication shop was largely undamaged. The roof sections of the main building showed little or no blast damage from within the building. The LPG tank within the yard was partly dislodged.

The Stockline warehouse remained intact.

The pattern of the damage showed that the seat of the explosion had been at the Hopehill Road end. The steel and concrete floor section of the despatch area had been supported by steel pillars. The pillars were encased in brick with concrete infill and were attached to a concrete base resting on the basement floor. A powerful force had been exerted on the basement area and ground floor. The steel floor was forced up at the west gable wall of the building but remained fixed at the east end of the basement where it was bolted to the concrete floor. The welds between the steel

chequer plate and the support beams were broken. The concrete floor was destroyed. This damage was characteristic of large sudden forces, such as would be produced by an explosion from below the steel floor.

The likely mechanism of the explosion was that it started to vent through the doorway to the stairwell, but that that had little effect in limiting the overpressure. The floor of the despatch area then started to lift and to break apart, thereby venting the explosion into the ground floor. The high pressure from the basement was directed onto the walls at the west gable end of the building. The explosion overpressure exerted forces on the basement walls and ceiling. The basement dividing walls then failed. That created a single space partly obstructed by the stone piers. Any excess of explosive atmosphere present in the initial space then mixed with the air from the spaces opened up and magnified the explosion. The steel sections of the floor lifted at an angle towards the gable end. The overpressure continued and started to remove the chequer plates upwards.

The pressure vented out on the south and west sides because the steel plate floor was more strongly secured at its east end. The effect displaced the central line of vertical cast iron columns that ran longitudinally along the internal centre line of the building on each floor and were held in place by gravity. In turn, the transverse double beams and floor joists that rested on the columns, and were also held in place by gravity, were displaced. The term "disproportionate collapse" is used to describe the collapse of a structure where the magnitude of the initiating event is comparatively small compared with the degree of the collapse. The collapse of the building was not

disproportionate in view of the magnitude of the explosion and the resulting overpressure. Alterations carried out to the building in the course of its history had no significant effect in relation to its collapse. There was no significant pre-event damage to the building and no significant deterioration of it by age or use.

Several pieces of the concrete ground floor were found some distance away. The displacement of these fragments was consistent with there having been an explosion. The two largest pieces were about 60 metres from the building. Their distinctive type and colouring indicated that they came from the floor of the despatch area. That indicated that the explosion preceded the collapse of the building.

Analysis of the structural damage to the steel floor sections showed that the explosion caused an overpressure of at least 0.692 bar in the basement.

The fall of the basement partition walls demonstrated that the ignition occurred in the basement area where Kenneth Murray's body was found. His injuries were consistent with his having been at the point of the explosion. Blood samples showed that he had inhaled propane gas before the explosion. That was consistent with the presence of LPG in the basement. It appears that Kenneth Murray had just entered the basement and had disturbed the LPG which had collected there at an explosive concentration.

Access to the basement was by the stairwell to the left of the ramp located at the despatch area. There was a door that had been put in place by Andrew Galloway and Kenneth Murray in about 1998. They and James

McGoldrick had keys for the door. Spare keys were held in the offices. The door hinged to the right and there was a light switch to the left. The switch operated a fluorescent tube light which was at the bottom of a flight of 4 or 5 stairs. A ramp led down to the basement. At the bottom there was an entrance into the basement in the form of a doorway, but there was no door there. To the right, just inside the basement opening, was a light switch that operated fluorescent tube lighting in the basement. There was a main support pillar with a row of support pillars running along underneath the basement.

The ignition source cannot be identified with certainty. It could have been a spark from the light switch or a flame from a cigarette lighter. Some but not all of the wiring had been spark-protected.

The underground pipe connecting the LPG storage tank to the LPG-fired oven was excavated. There was a right-angled bend in the pipe near to the wall of the building. Where it turned from the vertical to pass horizontally through the basement wall the pipe was significantly corroded. There was a crack in the underside of the right-angled bend which caused a considerable leak close to the entry point of the pipe into the basement. The crack extended to about 71% of its circumference.

Corrosion of underground metallic pipework is most common near to a building because the soil nearest to the building has greater moisture, usually because of the run-off of rain. A test using a tracer gas demonstrated that there was a path through the basement wall, which would have allowed LPG leaking from the pipe to enter the basement of the building. LPG will track the easiest route and accumulate

at the lowest point. It can permeate through subterranean structures. Its exact route could not be determined with certainty in this case.

When the pipe was excavated, it was discovered that when the level of the yard had been raised, the section of the pipe in which the main leak occurred had been packed around with loose fill material. Beneath the surface hard-standing a large concrete slab rested on top of the pipe where it turned and entered the building. The main leak at the final bend had been caused by external corrosion aggravated by the weight of the piece of concrete that rested on it.

The leak developed in three stages: there was initial corrosion, then a combination of loading and corrosion which accelerated the failure, and a final opening of the crack because of its weakened state. The rate of release of LPG would have increased during the final stage. It was not possible to determine for how long the gas had been leaking into the basement.

Further examination of the pipe showed that

1. the steel pipework had originally been galvanised but otherwise had no other corrosion protection;
2. the screwed malleable iron fittings, straight couplings, bends and elbows joining lengths of pipework were, with one exception at the tank end, ungalvanised and had no other corrosion protection;
3. the pipe lengths and fittings were substantially corroded, with a significant reduction in wall thickness in the pipework overall;
4. the material used to form and fill the pipe track comprised a range of soil types classified as 'aggressive' to 'very

aggressive' in respect of their corrosive qualities, and the rubble in-fill contained large pieces of concrete that had been bearing directly on the underground pipework;

5. there was a further small leak in the section of the pipework that was situated about one-third of the distance from the tank to the basement. It resulted from perforation by external corrosion.

There was LPG in the soil around the pipe track in a pattern consistent with leakage from the underground pipework before the explosion. The possibility that the explosive atmosphere resulted from any other potential source, such as natural gas, dust or ground methane can be excluded completely.

Chapter 3 – The prosecution

In the week after the explosion the then Lord Advocate announced that the Health and Safety Executive (HSE) and Strathclyde Police would conduct a joint investigation and report to the Procurator Fiscal. On completion of the investigation, the need for a Fatal Accident Inquiry or for any other form of public inquiry would be considered.

In November 2006 the Crown took proceedings on indictment against ICL Plastics Limited and ICL Tech Limited under section 33(1)(a) of the Health and Safety at Work etc. Act 1974.

The charges alleged *inter alia* that there had been failures (1) to make a suitable and sufficient assessment of the risks to the health and safety of employees while at work in failing to identify that the pipework conveying Liquefied Petroleum Gas (LPG) from the bulk vessel storage to the premises presented a potential hazard and risk; (2) to appoint one or more competent persons to assist in carrying out such risk assessments; (3) to have a proper system of inspection and maintenance in respect of the LPG pipework concerned, and (4) to ensure, so far as was reasonably practicable, that the pipework was maintained in a condition that was safe and without risk to employees.

On 17 August 2007 at Glasgow High Court, the companies pled guilty as libelled to the charges.

The Crown and the defence agreed that the cause of the collapse of the building at Grovepark Mills had been an explosion; that the cause of the explosion had been the ignition of an accumulation of LPG in the basement area of the building; and that this accumulation

had been caused by the leakage of LPG from a corroded underground pipe that connected an above-ground LPG storage tank to an oven within the premises.

On 28 August 2007, ICL Tech and ICL Plastics were each fined £200,000.

Part 2

Chapter 4 – Liquefied petroleum gas

Liquefied petroleum gas (LPG) is the generic term for hydrocarbon fuel gases with the primary active constituents propane and butane. These constituents are derived from petroleum and can be readily converted to liquid form by the application of moderate pressure and/or refrigeration. LPG is normally supplied in the form of commercial propane.

In liquid form, it occupies a smaller volume than the corresponding volume of gas. At atmospheric temperature and pressure, 1m³ of liquid vaporises to form 274m³ of gas. As a liquid at ambient temperature, LPG exerts a pressure equivalent to its vapour pressure. It must therefore be stored in a suitable pressure vessel. The compressibility of LPG makes it particularly suitable for bulk storage and transportation. Due to the possibility of its expansion, LPG transported as liquid presents a greater hazard than that transported as vapour.

Vaporised LPG at atmospheric pressure is approximately one-and-a-half to two times heavier than air. Escapes of LPG therefore tend to flow along the ground or the floor and to accumulate at low points such as pits, sumps, drains, basements and the bilges of boats. Natural gas is lighter than air and therefore dissipates more easily into the atmosphere.

When LPG is released to atmosphere it vaporises and mixes with air. The mixture is flammable at concentrations of between 2% and 10%. It burns most energetically when the mixture is about 4% to 5% in air (a "stoichiometric mix"). At concentrations below 2% the mixture does not burn as it is too weak to sustain combustion. At concentrations about 10% it does not burn as it is too rich. By contrast, natural gas is flammable in air at

concentrations between 5% and 15% and burns most energetically at a mix of about 9%.

Because of its greater density and its flammability in air at lower concentrations, LPG presents a greater hazard than natural gas. The special hazards of LPG have been well understood for many years.

LPG fire and explosion incidents are relatively uncommon in relation to other incidents and where they do occur they relate mostly to LPG in liquid form. Only a small number of incidents can be found on HSE's databases involving LPG leaks from pipes. Only one of these was identified by the Inquiry as having occurred before May 2004 involving vapour rather than liquid. This incident occurred at Lightweight Body Armour in Daventry in 1988 and involved a vapour leak from a buried pipe operating at 30 psi (2 bar).

The greater risk presented by the loss of LPG in liquid phase has resulted in priority being given by HSE to producing guidance on liquid phase releases. According to HSE, "this is due to the fact that one volume of liquid will expand to give approximately 250 volumes of gaseous LPG and 12000 volumes of LPG at the lower flammable limit. As a result, the potential consequences of a leak of liquid compared with a similar sized leak of vapour are that much greater" ... "Whilst both LPG storage tanks and LPG pipework carry with them the inherent hazard of leakage of LPG, the risk of leakage and its consequences, are generally much greater for bulk storage vessels containing liquid LPG. The pressures are generally higher and the quantities that could escape are larger than for LPG pipework containing liquid, which in turn are greater

than that for vapour pipelines. This is borne out by the known incident record. The majority of large scale incidents involving releases of LPG, both nationally and internationally, are known to have involved bulk vessels as opposed to pipework... In contrast, the incident record suggests that the risk of deaths or injuries resulting from a low pressure LPG leak from a pipe is low, especially where bulk storage is not involved."

Although HSE considered the risk of a release of liquid LPG to be low, the potential consequences of such a leak can be high.

There may also be serious consequences if LPG leaks into an unventilated void. Users and suppliers must therefore adhere to the highest possible standards when storing and handling LPG.

Since LPG, like natural gas, is odourless in its natural state, a stenching agent is added to make it detectable, by persons with a normal sense of smell, at concentrations of one fifth of the lower limit of flammability. The stenching agent is an important safeguard against the risks of fire and asphyxiation which arise when higher concentrations of LPG accumulate in confined spaces.

Several witnesses in this case said that they did not smell the LPG stenching agent before the explosion. The explanation is that since the propane gas was heavier than air the smell would probably have been evident only in the basement.

Chapter 5 – LPG installations

Typical LPG installation for small commercial customers

The industry norm is for the LPG supplier to supply both the product and the tank to the industrial and commercial customer. Installations vary according to the supplier.

The following description relates to two of the industry's typical installations. It should be noted that, save for regulations 37, 38 and 41 and subject to regulation 3(8), the Gas Safety (Installation and Use) Regulations 1998 (GSIUR) as matters stand do not apply generally to 'factories' within the meaning of the Factories Act 1961.

The pipework within an LPG installation is defined by reference to the part of the installation within which it is incorporated. The service pipework is that which runs from the tank regulator to the emergency control valve (ECV). The GSIUR definition of service pipework

means "a pipe for supplying gas to premises from a gas storage vessel, being any pipe between the gas storage vessel and the outlet of the ECV". The installation pipework runs from the ECV to the isolation valve at the appliance. The GSIUR definition of installation pipework "means any pipework for conveying gas for a particular consumer and any associated valve or other gas fitting including any pipework used to connect a gas appliance to other installation pipework and any shut off device at the inlet to the appliance, but it does not mean (a) a service pipe; (b) a pipe comprised in a gas appliance; (c) any valve attached to a storage container or cylinder; or (d) service pipework". The "appliance pipework" runs from the appliance servicing valve to the appliance itself.

Calor supplied details of the set-up of their typical LPG installation. For the most part it is typical of the industry. The diagram below illustrates this.

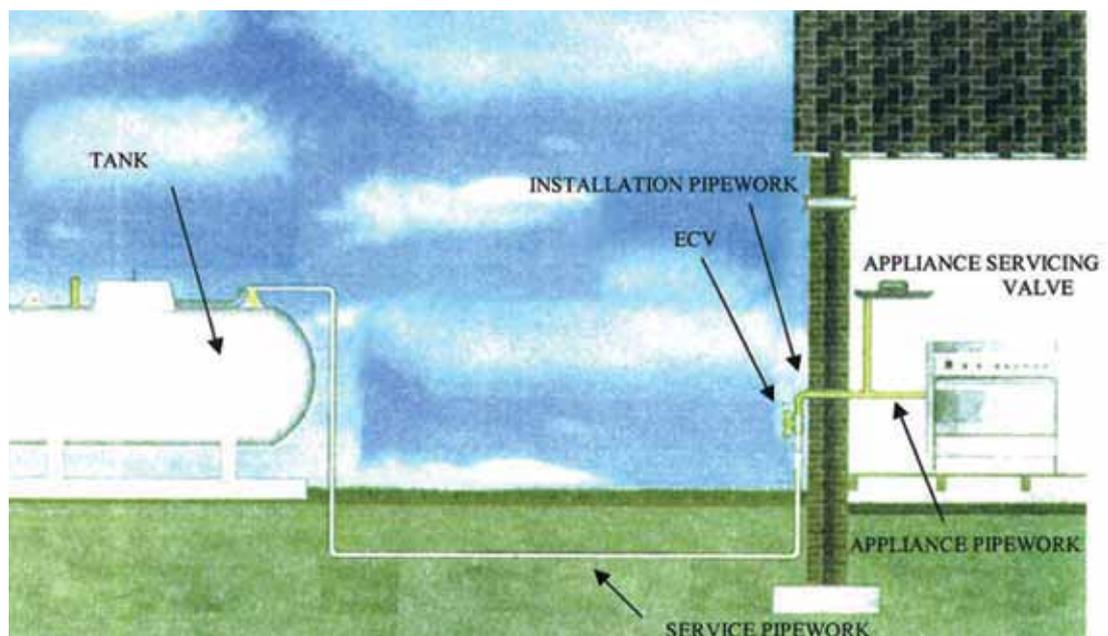
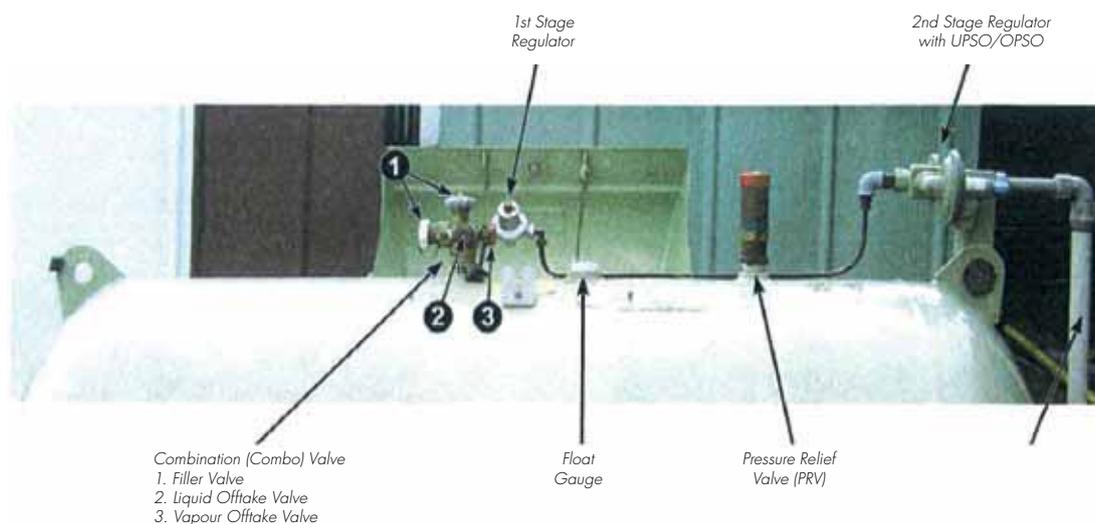


Figure 2 - Calor diagram

3 IN-LINE VESSEL LOW PRESSURE INSTALLATION



5 IN-LINE VESSEL LOW PRESSURE INSTALLATION

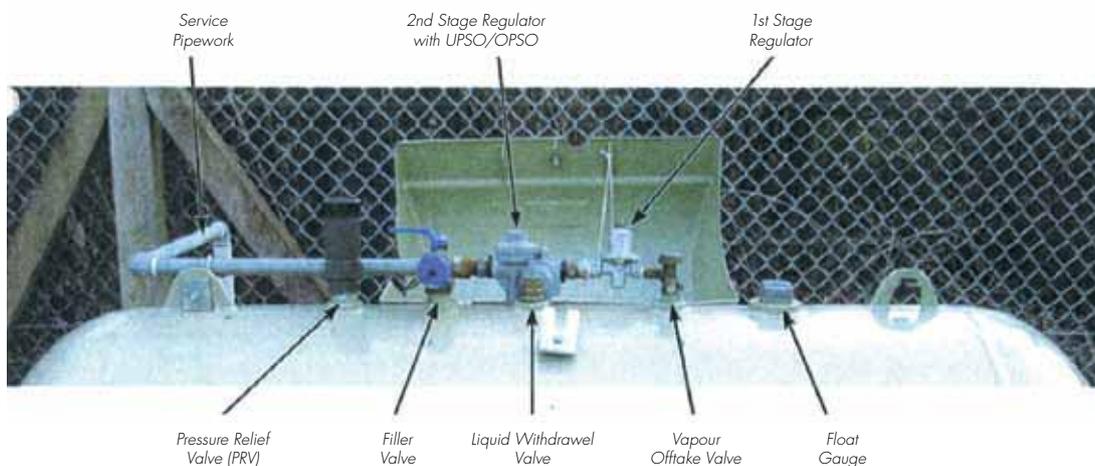


Figure 3

On top of the tank, there are three valves, which may be located separately, or may be grouped together in a single combination valve. Those valves are the filler valve, used in the filling of the tank; the liquid withdrawal 'off-take' valve, used for the removal of liquid for maintenance purposes; and the vapour off-take valve, from which the vapour travels out of the tank into the pipework.

There are two further items on the top of the tank itself; the float gauge, which indicates the level in the tank, and the pressure relief valve.

An installation with a combination valve, pressure relief valve and float gauge is referred to as a three-in-line. Where the filler, liquid off-take and vapour off-take valves are separated on the top of the tank it is referred to as a five-in-line.



Figure 4 – ICL tank with the hood off

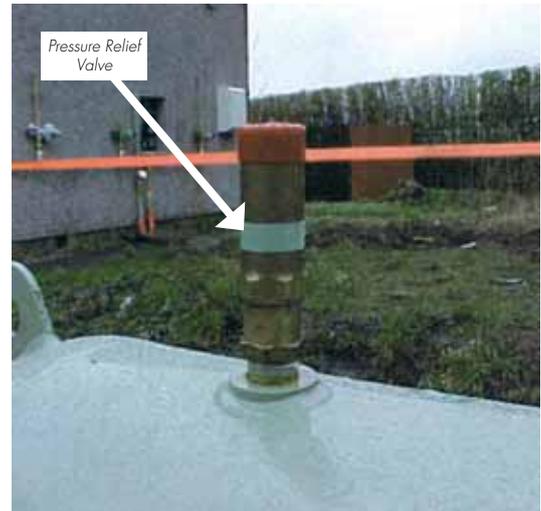


Figure 5 – Pressure Relief Valve



Figure 6

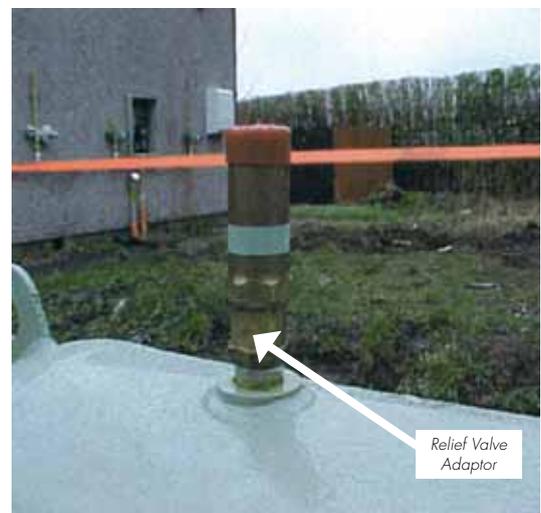


Figure 7 – Relief Valve Adaptor

The LPG is stored as liquid within the tank, at normal vapour pressure of about 7 bar. After leaving the vapour off-take valve, the vapour passes through the first stage regulator, which effects an initial reduction in pressure from about 7 bar to 0.7 bar. Thereafter, it passes through a second stage regulator, which reduces the pressure from 0.7 bar to about 37

millibar, the usual and safe operating pressure. Underpressure and overpressure valves are normally incorporated within the second stage regulator. The former shuts off the supply if there is a drop in pressure at the tank end of the installation; for example, if the tank runs dry. The latter shuts off the supply if there is an increase in pressure; for example, if the regulator fails.

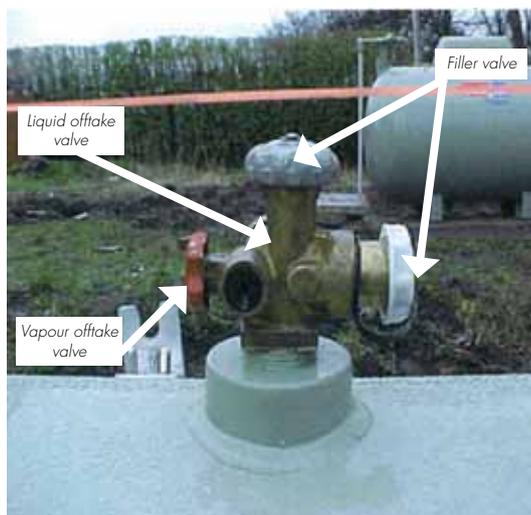


Figure 8 – 3-in-line valve installation

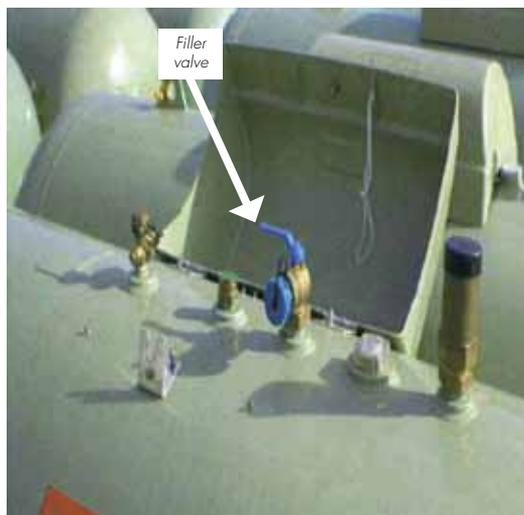


Figure 9 – 5-in-line valve installation

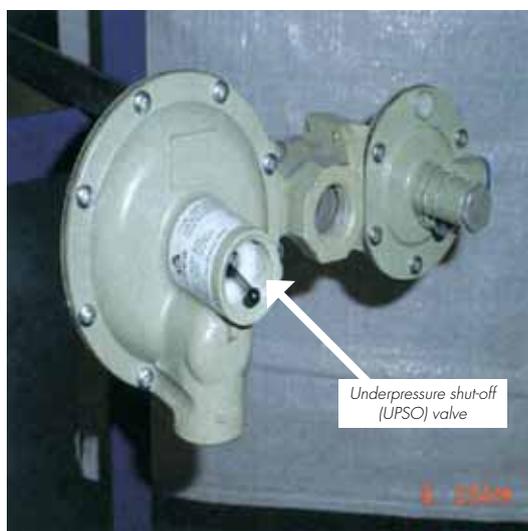


Figure 10 – 2nd stage regulator



Figure 11 – 2nd stage regulator

The positions of the first and second stage regulators vary. The first stage regulator is often connected directly into the combination valve. The second stage regulator is often connected directly to the first stage regulator. Alternatively, the first stage regulator may be sited some distance away from the tank. The two regulators may be widely separated, with the first stage

regulator sited at or near the tank, and the second stage regulator close to the entry point to the building that the installation serves. In that case, any section of underground pipework that connects the two regulators will be carrying vapour at about 0.7 bar, rather than at the reduced pressure of 37 millibar. The first stage regulator is commonly sited away from the tank

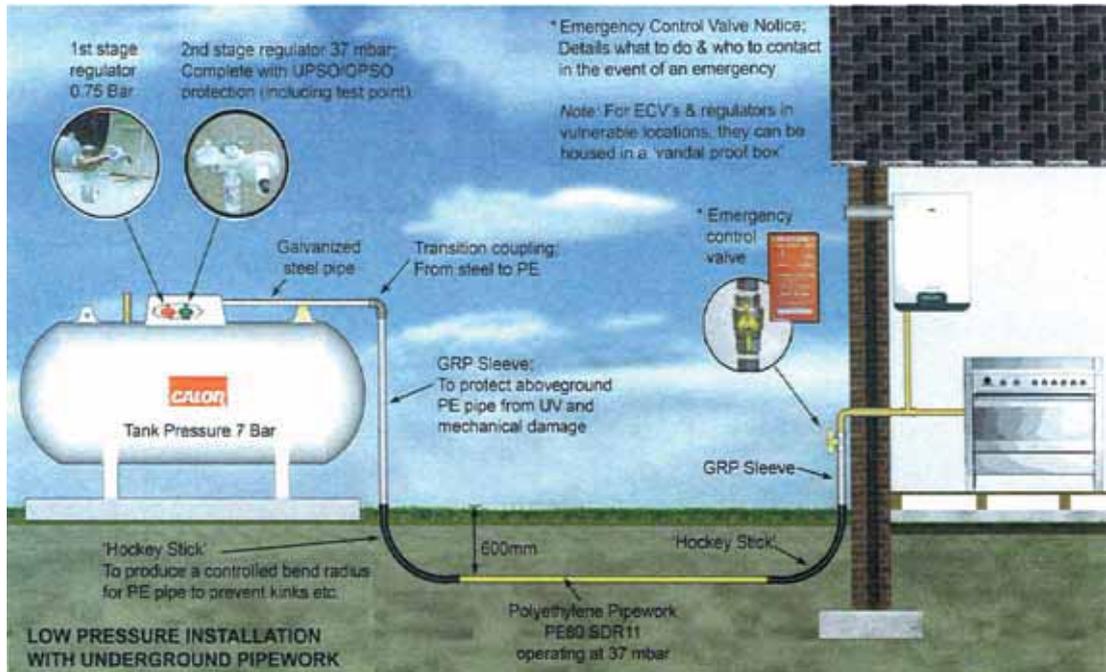


Figure 12 – Typical single bulk vessel operating with vessel mounted regulators and low pressure underground pipework

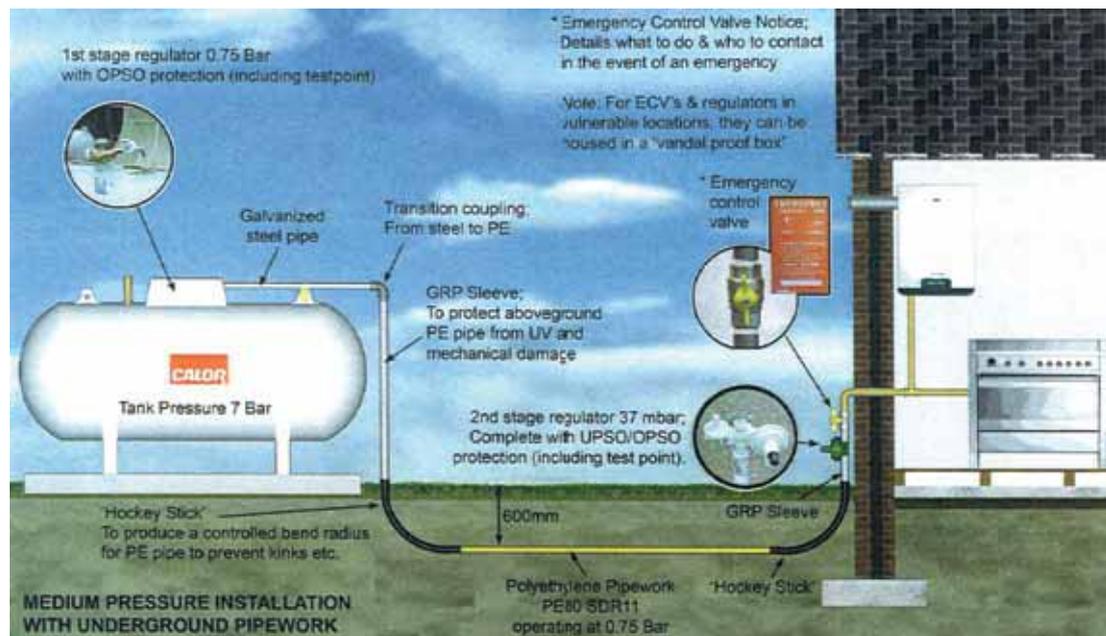


Figure 13 – Installation with 2nd stage regulator close to building entry point

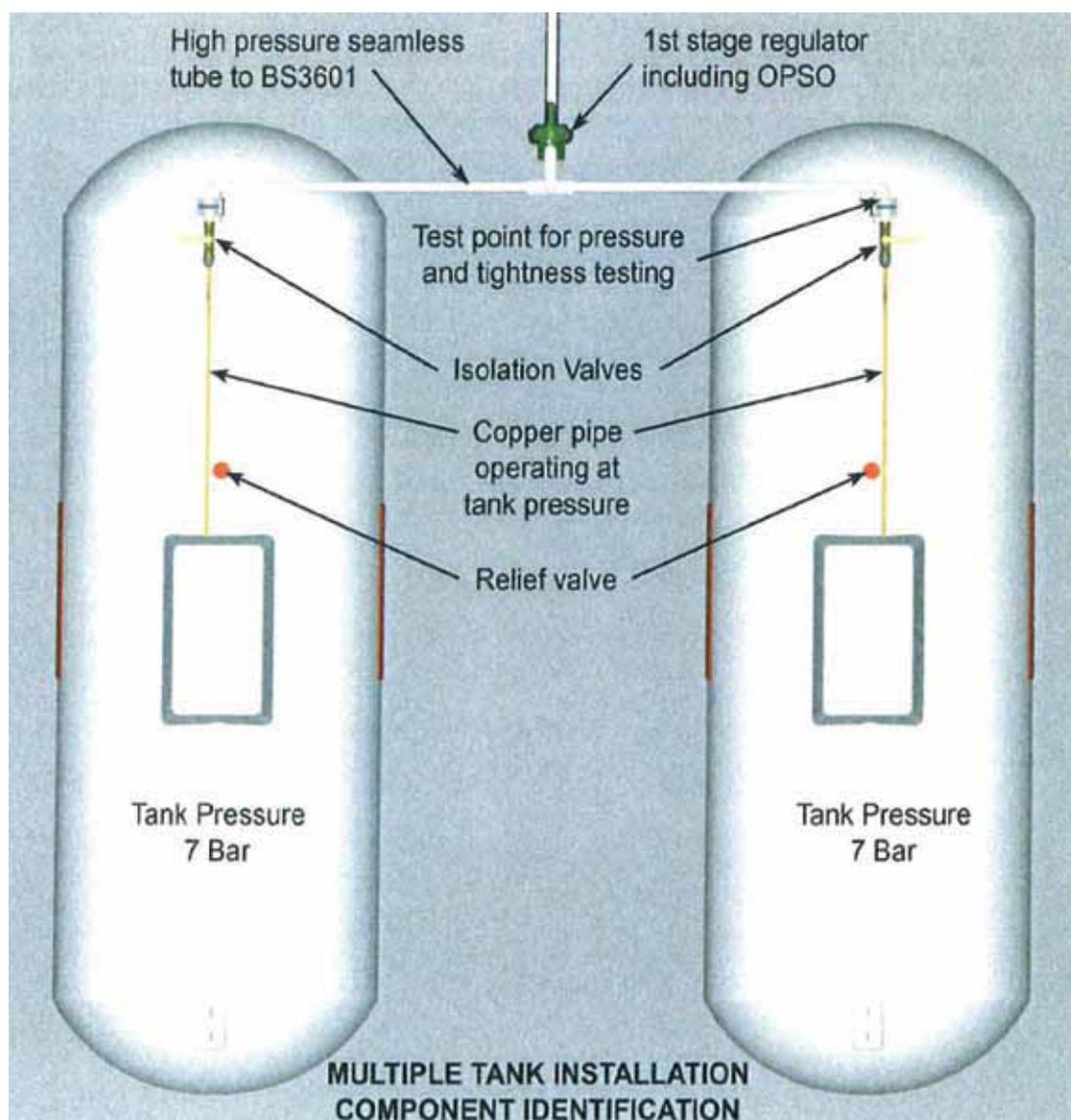


Figure 14 – 1st stage regulator serving 2 tanks

where there is a manifolding or joining together of two tanks and the first stage regulator serves both. In that case, the first stage regulator is usually supported on the pipework which enters the ground (Fig. 14).

Exceptionally, installations may have a single regulator effecting a one-stage reduction of operating pressure. In more modern installations,

the pressure reduction may be effected in three stages.

Where an installation incorporates a section of underground pipework, the vapour leaves the last of the valves on the tank by way of metallic pipework, which connects to a polyethylene (PE) upright by way of a transition coupling.



Figure 15 – Typical Emergency Control Valve (ECV) on outside of property

The upright section is covered by a Glass Reinforced Plastic (GRP) sleeve, which protects the PE against both mechanical damage and degradation by U V light. Where it enters the ground, the PE pipework is covered by black tubes, known as “hockey sticks” which give a standard radius to the pipe thereby preventing it from over-bending or being crushed.

Where the pipework re-emerges from the ground near the building, it will again be protected by a hockey stick and GRP sleeve. It passes through a transition fitting into the emergency control valve (ECV), which can turn off the supply. After the ECV, the pipework often changes to copper which is sleeved as it passes through the wall of the building. There is generally a warning sign beside the ECV, specifying what is to be done if there is a gas escape.

If the pipework between the tank and the building is above ground, galvanised steel is used rather than PE.

The typical installation used by Johnston Oils is different from Calor’s in only minor respects. Johnston Oils prefer not to use a combination valve on top of the tank. Where the second stage regulator is installed on the tank, they generally place it further along the pipework leading from the vapour off-take valve, at a distance from the first stage regulator. Johnston Oils, like Calor, have installations with one or both of the regulators sited further downstream from the tank.

The use of metal and polyethylene in buried service pipework

Pipework of various materials has been used in underground sections of service pipework. In the past, service pipework was usually metallic. Such pipework was usually galvanised, often with a thin zinc coating, to protect against corrosion. It was often also wrapped with Denso tape, a proprietary tape used as corrosion protection. For Denso tape to be effective the pipework must be carefully prepared and the tape must be applied in a particular way. This is a difficult procedure. It is often not adhered to properly. Unprotected buried metallic pipework is likely to have a lifespan of about thirty years; but corrosion leading to failure and leakage can occur considerably sooner than that.

Polyethylene first came into use in the 1980s. At that time, only a limited number of installations were installed with all-polyethylene pipework. From 1983 to about 1992 the practice was to use polyethylene for the buried section of the service pipework, with metallic risers at either end. The understanding at that time was that the metallic riser gave better protection than polyethylene against fire and mechanical damage. In due course, the LPG industry

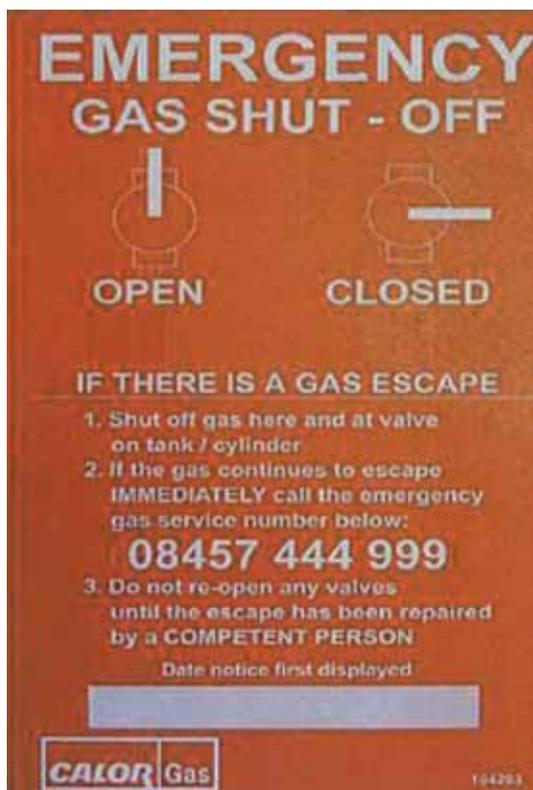


Figure 16 – Typical ECV label

became less concerned about that risk and came to use polyethylene risers protected by GRP sleeves. Where risers were made of steel, the parts of them below ground level were generally protected against corrosion by being galvanised and wrapped with Denso tape.

From about 1993 onwards, the great majority of new installations used only polyethylene pipework. Recent research into installations installed before 1993 disclosed that of those examined, 73% had polyethylene service pipework with metallic risers, 13% had polyethylene pipework only, 9% had metallic pipework only, and 5% had pipework of copper or multiple materials.

The standard material currently used for underground service pipework is polyethylene. The norm is that all the pipework incorporated in an installation will be made of polyethylene. Mr Tomlin of Calor Gas said that it is not susceptible to corrosion and has a lifespan of about fifty years. Dr Fullam of HSE said that “polyethylene (PE) pipe is impervious to most corrosion mechanisms including those that are biologically based. Medium density PE is manufactured without a plasticiser and it is therefore less likely to become brittle over time as a result of the loss of the plasticizer. PE pipes can last in excess of 25 years. The main reason for failure is human interference, for example, someone digging it up”.

Tightness test and proof test

A tightness test may also be described as a soundness or leak test. It is a pneumatic pressure test to ensure the gas tightness of pipework fittings and components. It may also be used to check the effectiveness of shut-off devices. It is carried out on an exchange of tanks, and after any work is carried out on a gas fitting that might affect the tightness of the overall installation. The definition of a tightness test in IGE/TD/4 polyethylene and steel gas services and service pipework is “a specific procedure to verify that pipework meets requirements for gas tightness”.

GSIUR details the legal requirements for tightness testing LPG installations. Regulation 6(6) provides that:

“Where a person carries out any work in relation to a gas fitting which might affect the gas tightness of the gas installation he shall immediately thereafter test the installation for gas tightness at least as far as the nearest valves upstream and downstream in the installation.”

A proof test, otherwise known as a strength test, is a pressure test to establish that the mechanical integrity of pipework, fittings and components meets the required standard. It is carried out at a higher pressure than a tightness test, above the operating pressure of the installation, and is used to determine the strength of a system following its construction. A proof test should not be carried out on an installation with which the engineer is not familiar. If an engineer raises the pressure of a system above the normal operating level without knowing how the installation was designed, what it is constructed of and how it was constructed, he risks his own safety and that of others in the vicinity. The definition of a strength test in IGE/TD/4 is “a specific procedure to verify that pipework meets the requirements for mechanical strength”.

When Maurice Coville of Calor gave advice about the ICL installation, as I shall later describe, a tightness test was understood by the LPG industry to be an appropriate method for determining the integrity of an underground pipe. I deal with that part of the history later.

It is now recognised that a tightness test carried out on existing buried pipework gives no indication of its integrity. Even though a tightness test is satisfactory, the pipework may be in poor condition and may be about to develop a leak. A tightness test should be used in conjunction with other appropriate methodologies to determine the overall suitability of the pipework for its continued use; for example, a leakage survey, records, operating pressure, material of construction, and so on.

Responsibilities for the Commercial/Industrial LPG Installation

The responsibilities of the supplier and the user

for an LPG installation are determined by the terms and conditions of the supply contract. In general, the supplier is responsible for the tank, together with the associated pipework up to either the vapour off-take valve or the first stage regulator. I discuss this important distinction later. The supplier is generally not responsible for the service pipework downstream of either point. Any service pipework between either point and the emergency control valve, whether buried or not, is the responsibility of the user.

The responsibilities of supplier and user in the natural gas industry are different. Responsibilities for natural gas are divided into two categories: transportation and supply. A natural gas transporter is responsible for the transportation and conveyance of the gas as far as the emergency control valve, while the supplier has responsibility for supplying from the emergency control valve through to a meter regulator, which is regarded as the end of the network. The user has responsibility for the installation after the meter. Therefore, the transporter will generally have responsibility for any buried service pipework up to the emergency control valve, whether it is outside or inside the building.

Regulation 37 of the Gas Safety (Installation and Use) Regulations 1998 (the GSIUR) carries with it certain responsibilities in the event of a gas leak. In particular, it imposes an obligation to prevent an escape of gas within twelve hours of its being notified. In relation to natural gas, that obligation lies with the transporter. In relation to LPG, it lies with the supplier.

There is a difference of approach between LPG suppliers as to the point up to which the supplier takes responsibility for the installation. Calor’s responsibility for it ends at the vapour

off-take valve. Johnston Oils takes responsibility up to the first stage regulator, a position that seems to be regarded by UKLPG as the industry norm. Suppliers such as Johnston Oils take that approach whether the first stage regulator is situated at the tank or is remote from it. It is my impression that before evidence on the point came out at the Inquiry, the industry seems not to have regarded these differences in approach as being significant.

It is usual industry practice for the supplier to install the service pipework up to the emergency control valve, although the supplier will not have ultimate responsibility for it. Nothing is visible on the installation in terms of a notice or colour coding to indicate where responsibility passes from the supplier to the user. The usual practice is that users are made aware of their responsibilities for service pipework through the contract and, in the case of Calor, by the provision of a welcome pack.

Tank exchange

It is relatively common for LPG users to change supplier at the end of a contract. The outgoing supplier removes its tank, and the incoming supplier connects its own tank to the installation. The LPG industry considers that the use of an integrated system makes it easier for the user to change suppliers. An exchange of tanks of this kind is generally described as a like-for-like exchange. The result is that the new supplier may know nothing of the history and condition of the pipework to which its tank is being connected.

Different approaches are adopted by different suppliers when taking over the supply to an existing installation. Calor's procedure is to install the tank, carry out a visual inspection of

pipework that is above ground, and carry out a tightness test on the installation. Calor assume that the customer has fulfilled all responsibilities in relation to any section of underground service pipework and that it is in safe condition. Calor's procedure in this respect has not changed since 2004. Johnston Oils adopted the same approach as Calor until 2004; but since 2005, in response to the ICL disaster, they have carried out a full risk assessment of the installation when taking over a supply. This may lead to their recommending replacement of the underground service pipework should there be any doubt as to its age or condition. If the user does not follow such recommendations, Johnston Oils will refuse to supply to the installation.

It is now recognised by the industry that the carrying out of a like-for-like exchange may give rise to difficulty where the outgoing and incoming suppliers operate different regimes of responsibility for the installation. Industry practice seems to have been to assume that in a like-for-like tank exchange there was a like-for-like exchange of responsibilities.

But if the outgoing supplier takes responsibility to the first stage regulator, and the incoming supplier takes responsibility only to the vapour off-take valve, the user may not realise that it has assumed responsibility for the service pipework in between.

Strengths and weaknesses of the present system regarding responsibility for service pipework

It was accepted by all relevant witnesses that it was undesirable that different approaches should be adopted by different suppliers with regard to responsibility for pipework.

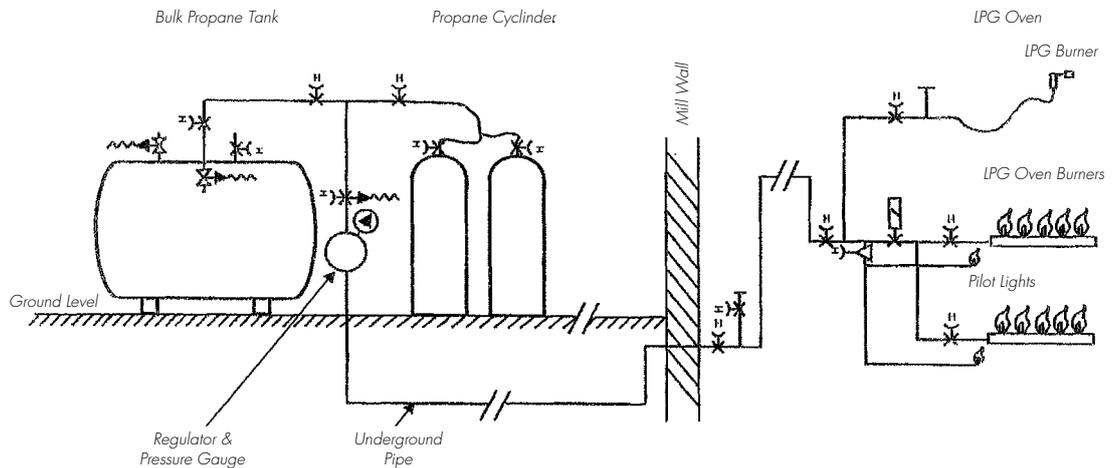


Figure 17

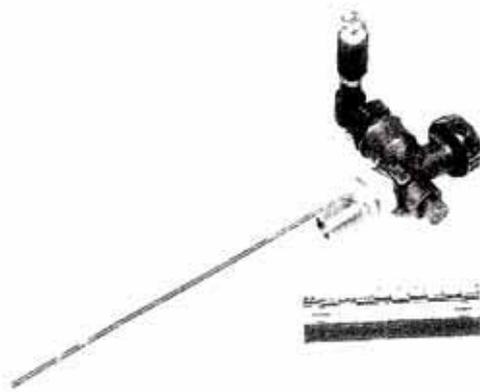


Figure 18 – The vapour take off valve fitted to the one-tonne propane storage tank

All of the witnesses who discussed the point were unanimous in their view that responsibility for service pipework should remain with the LPG user. They reached that view on the basis that it is the user who has day-to-day control over the site and, therefore, the service pipework, together with knowledge of the installation downstream of the tank and associated valves. A supplier would also face difficulties

in obtaining insurance for a liability in respect of the service pipework since that was a risk which it could not control. There is an important distinction between the natural gas and the LPG industries in that the natural gas customer has no control over a gas escape upstream of the emergency control valve, whereas an LPG customer can control the supply of gas into the service pipework by simply closing the isolation valve at the tank in the event of an escape. The proper comparison to be drawn, I think, is not between LPG and natural gas, but between LPG and other packaged fuels and chemicals, such as oil and compressed gas.

One of the important questions in this Inquiry is whether the supplier's responsibility should end at the vapour off-take valve, in accordance with Calor's practice, or at the first stage regulator, in accordance with the general industry view. Calor consider that making the demarcation at the vapour off-take gives a degree of certainty that is not present if the first stage regulator is regarded as the relevant point, because the first stage regulator may be located at different places at different sites. On the other view, it may be desirable for the pipework up to the

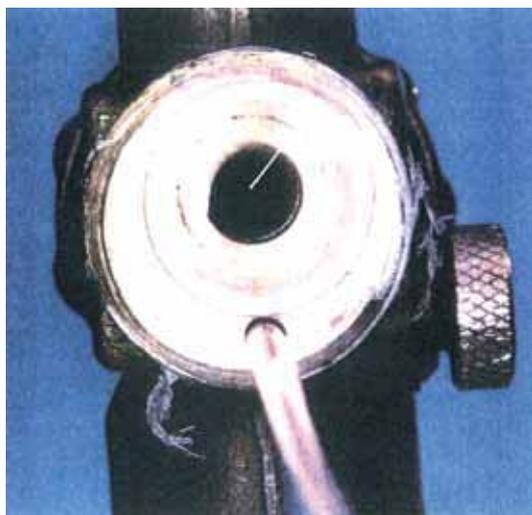


Figure 19 – The witness marks (arrow) left by the missing excess flow valve spring

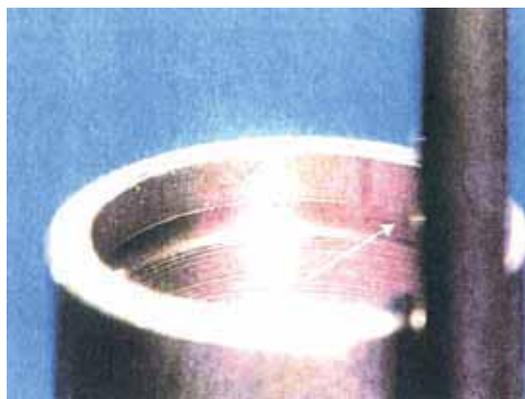


Figure 20 – The witness marks (arrow) in the circlip groove left by the missing excess flow valve circlip

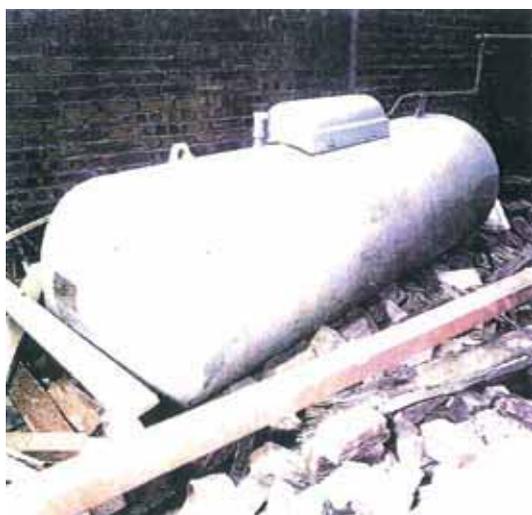


Figure 21 – The one-tonne storage tank



Figure 22 – The two manifolded 47kg propane cylinders

first stage regulator to remain the responsibility of the supplier, since it contains high pressure vapour. I shall discuss this question later.

The ICL Installation

The diagram (Fig. 17) represents the ICL installation at the date of the explosion. The complete LPG system consisted of a one tonne

tank, two 47 kg cylinders, surface pipework and regulator, underground pipework to the basement of the building, pipework within the building, LPG oven and ancillary items.

The one-tonne tank that had been fitted by Johnston Oils on 29 November 1998 was fitted with a vapour off-take valve (Fig. 18).



Figure 23 – The position of the LPG pipe as it enters the ground from the one-tonne propane storage tank end.



Figure 24 – The LPG underground pipeline enters the building in an alcove in the basement

Although the valve appeared to have been originally fitted with an excess flow valve, which fitted into the base of the valve, the inner workings of the valve were absent when Dr Hawksworth inspected it. There was evidence that the working components of the valve had been in place at some time. This type of excess flow valve is intended to protect against a full pipe failure, or shear. It is not intended to offer any protection against a crack or a split in the pipe; nor to protect an underground pipe. The ICL installation was unusual in that there was no second stage regulator because of the high operating pressure of the oven.

The pipework from the tank was initially 10mm outer diameter (OD), nominal internal diameter (ID) 8.4mm, copper tubing connecting to 1 inch steel pipe about 0.5m from the outlet. The one inch pipe fed back to a T-coupling (through an in-line valve) where a further flexible hose, also fitted with an in-line valve, connected to two 47 kg propane cylinders. The other side of the pipe T-coupling then dropped down to a vertical

section of pipe that incorporated a further valve and a high pressure regulator. Below the regulator the pipe went underground.

The underground pipe went from the position close to the tank to enter the building in an alcove in the basement. It then went up through the dispatch floor to the ground floor ceiling eventually to connect to the LPG oven. The valve shown (Fig. 24) was, in the past, used to isolate the LPG supply into the building.

Chapter 6 – The LPG industry

UKLPG

The trade association of the LPG industry is UKLPG. UKLPG was formed in January 2008, by amalgamation of the LPGA (the LPG Association) and ALGED (the Association for Liquid Gas Equipment Distributors), which were formed in 1947 and 1975 respectively. Its main purpose is to promote the highest safety and technical standards. It encourages its members to assist it on such matters. It keeps its members informed of forthcoming changes that might affect the industry and provides them with all relevant Codes of Practice. I discuss these in more detail in Part 3.

Most of the members of UKLPG are retail suppliers to direct end users, who are generally small customers. The industry is dominated by four majors, namely Calor Gas, Flo Gas, Shell and BP. Several wholesale suppliers are members, including Total, Conoco Philips and Texaco Chevron. The membership of UKLPG accounts for 95% of suppliers of LPG in the UK. The remaining 5% account for only about 1% of the total quantity of LPG supplied in the UK. They are mostly independent companies, often operated by individuals who have previously worked for larger suppliers. For the most part they observe the UKLPG Codes of Practice.

Members of UKLPG are obliged to adhere to its Articles of Association and to comply with its Codes of Practice. UKLPG has the power to suspend or expel members for breaches of its Codes of Practice. It will generally find out about a member's failure to adhere to a safety requirement through a complaint by the public or by a fellow member. The Board reviews any complaints received. In twenty years, UKLPG has had to suspend only one member for a serious breach of safety.

I am impressed by the quality of UKLPG's work in its field. It has produced an updated Code of Practice that is comprehensive and incorporates the lessons of experience. The Code has followed a careful process of consultation within the industry and with HSE. The paramount aim of the Code is safety. UKLPG's approach is not based on considerations of cost.

UKLPG has made an outstanding contribution to this Inquiry. It has provided a detailed survey of the history of the practice of the industry and a reasoned and constructive response to the recommendations of Mr Sylvester-Evans.

Institute of Gas Engineers and Managers (IGEM)

The Institute of Gas Engineers and Managers (IGEM) is the chartered body for gas industry professionals and draws representation from both the natural gas and LPG industries. IGEM has published industry standards since the 1960s, including those on gas and mains services.

Part 3

Chapter 7 – The regulatory system

Introduction

The regulatory regime is extensive in relation to LPG, but in most cases is not specific to it. It consists of primary legislation, secondary legislation, codes of practice, HSE guidance, industry guidance, and building, planning and fire legislation. I do not propose to analyse this wealth of material in detail. It is sufficient for the purposes of this inquiry to say that the legislation is complex and is spread over a multiplicity of statutes and regulations. Much of it reflects the changes in emphasis in health and safety legislation over the years.

The diversity of these sources and the many problems of interpretation of them make it difficult for the layman to understand the law. That in itself is a significant weakness in the present safety regime.

Health and Safety

Health and safety in essence means the management of the risks to people's health and safety from work activities. To be truly effective, health and safety has to be an everyday process supported by everyone involved as an integral part of workplace culture - employers, employees, third party organisations such as STUC, TUC, employer organisations, trade associations (notably UKLPG in the context of the subject matter of this report) consultant firms and voluntary organisations producing health and safety guidance.

The Health and Safety at Work Act 1974 and its underlying principles and philosophy provide a legislative framework that is adaptable.

The Act established the simple principle that those who create risk are best placed to manage it. This applies whether the risk

maker is an employer, is self-employed or is a manufacturer or supplier of articles or substances for use at work. Each risk maker has a range of duties that must be implemented to manage the risk.

All workers have a fundamental right to work in an environment where risks to health and safety are properly controlled. The primary responsibility for this lies with the employer. Workers also have a duty of care for their own health and safety and for the health and safety of others who may be affected by their actions. The legislation requires that workers should co-operate with employers on health and safety issues.

The Act led to the setting up of the Health and Safety Commission (HSC) and the Health and Safety Executive (HSE) and established HSE and local authorities as joint enforcers of health and safety law. On 1 April 2008 HSC and HSE merged to form a single entity known as the Health and Safety Executive (HSE).

HSE is the national regulatory body responsible for promoting the cause of better health and safety at work within the United Kingdom. It works in partnership with local authorities to provide strategic direction and to lead the management of the risks to health and safety from work activities as a whole. To do this it conducts research, proposes new regulations where and when needed, introduces new or revised regulations and codes of practice, alerts duty holders to new and emerging risks, provides information and advice and promotes training. Its focus is on identifying practical steps and measures which can be taken by duty holders to reduce the risks that people may be killed, injured or made ill by work activities.

Its key role is to ensure that duty holders are motivated to do the right thing because it makes sense and to support the duty holders in integrating health and safety into their functions and responsibilities in a commonsense and proportionate way.

Enforcement has three main objectives: 1) to seek to compel duty holders to take immediate action to deal with the identified risk; 2) to promote sustained compliance with the law; 3) to look to ensure that duty holders who breach health and safety requirements, and directors or managers who fail in their responsibilities, are held to account for their actions.

Better Regulation

The Better Regulation Commission's summary, updated in December 2007, is that the five principles of good regulation should be:

- Proportionate: Regulators should only intervene when necessary. Remedies should be appropriate to the risk posed, and costs identified and minimised.
- Accountable: Regulators must be able to justify decisions, and be subject to public scrutiny.
- Consistent: Government rules and standards must be joined up and implemented fairly.
- Transparent: Regulators should be open, and keep regulations simple and user friendly.
- Targeted: Regulation should be focused on the problem, and minimise side effects.

Competency

There is confusion in the health and safety environment between a qualified person and a competent person. The legislation makes requirements for engagement of a "competent" person. In essence a person is to be considered competent if he has the ability to apply

knowledge in a way that is proportionate, meaningful and useful to the intended audience.

The essence of competence is said by HSE to be relevance to the workplace with the requirement that there is a proper focus on both the risks that occur most often and those with serious consequences. Competence is the ability for every director, manager and worker to recognise the risks in operational activities and then apply the right measures to control and manage those risks.

Hierarchy and status of legislation

The primary legislation is the Health and Safety at Work Act 1974 (HSWA). It allows for secondary legislation, usually in the form of regulations and approved codes of practice. Regulations are made by the appropriate Minister, normally on the basis of proposals submitted by HSE after consultation. They have to be laid before Parliament for a period of 21 days before coming into force. It is a criminal offence to fail to comply with any requirement of a regulation.

Approved codes of practice (ACoPs) are approved by HSE with the consent of the appropriate Secretary of State. They do not require agreement from Parliament. ACoPs have a special authority in law. Failure to comply with an ACoP may be taken by a court in criminal proceedings as evidence of a failure to comply with the requirements of the Act or of regulations to which the ACoP relates, unless it can be shown that those requirements were complied with in some equally effective way. ACoPs therefore provide flexibility to cope with invention and technological change without a lowering of standards.

HSE also publishes non-statutory guidance to accompany regulations. Guidance is not compulsory. In comparison with subject-specific regulations, guidance is more straightforward and quicker to produce. It is also simpler to keep up to date. Health and safety inspectors may refer to guidance to illustrate good practice.

The industry is often best placed to produce its own guidance and codes of practices from its collective experience and knowledge of the hazards, risks and best practice. On this approach the industry itself advocates and promulgates best practice. Since 1998 much of this guidance has been produced in collaboration with HSE. Codes of Practice produced by UKLPG are prepared in consultation with HSE. Some carry an HSE foreword stipulating that the UKLPG Codes of Practice are not to be regarded as an authoritative interpretation of law but that to follow them will be regarded normally as doing enough to comply with the health and safety law. There is a strong demand from users for non-statutory guidance of this kind.

Information from HSE's inspections and investigations is used when identifying standards, which may be published as informal guidance or as formal standards. The British Standards Institution is the national body responsible for the development of British standards. The great majority of these are transposed European or international standards, for example BS5482 – Code of Practice for Domestic Butane and Propane Gas Burning Installations. They are sometimes referred to in HSE's published guidance. Occasionally, compliance with standards is required in health and safety regulations and codes. In a policy

statement published in 1996, HSE emphasised the continuing importance of standards as a form of guidance in promoting health and safety.

The history of the legislation, regulations codes and guidance

To assist in the interpretation of the history of this case, I set out in Appendix 3 a table showing the legislation, regulations, codes and guidance that were in force at the key dates. As indicated in the table, some of the earlier guidance referred to was internal to the Factories Inspectorate and the HSE.

The relevant dates relating to the ICL installation have been marked on this table. They are the date of installation (1969), the date at which the yard was raised (January 1973), the date on which the LPG tank was exchanged by Calor (1982), the date of the Ives/Coville compromise (1988), the change of supplier from Calor to Johnston Oils (1998) and the date of the explosion (11 May 2004).

Part 4

Chapter 8 – The ICL group of companies

The ICL group consists of privately owned limited companies. ICL Plastics Limited is the holding company. ICL Technical Plastics Limited and Stockline Plastics Limited are two of its six operating subsidiaries.

ICL Plastics Limited

ICL Plastics Limited (ICL Plastics) was incorporated on 17 November 1961 with its principal object being:

“to carry on the business of processing plastics by all methods including ‘fluid bed’ plastic dip coatings in various finishes, cold plastic spraying, plastic sheet welding, plastic slush moulding, plastic vacuum forming and fibreglass resin bonded moulding”.

Campbell Downie was the sales and finance director. Ronald Cunningham was the production director. He resigned in 1966. Latterly, Campbell Downie had non-executive duties.

Campbell Downie’s wife Lorna was appointed company secretary on 26 April 1972. On 25 May 1972, Ronald Ferguson and Stewart McColl were appointed as directors.

In May 2004 Campbell Downie’s shareholding, and minimal shareholdings held by his children, amounted to 68% of the shares in ICL Plastics. Ronald Ferguson held 28% and Stewart McColl held 4%.

Between 1973 and 1975, subsidiary companies were created for the manufacturing and distribution operations. ICL Plastics, as the holding company with Campbell Downie as chairman, became responsible for maintaining

the group’s financial resources, providing accounting and IT services, carrying out strategic market analysis and undertaking research and development. Mr Downie withdrew from all executive duties in the subsidiaries after executive directors were appointed.

ICL Technical Plastics Limited

ICL Technical Plastics Limited was incorporated on 26 November 1973 to continue to develop and specialise in production methods. Its principal object was the same as that of ICL Plastics.

The ownership and responsibility for the fixed plant and equipment to carry out this function were transferred from ICL Plastics to ICL Technical Plastics Limited. There was no transfer of the title to the site.

Campbell Downie and Lorna Downie were the initial directors. Lorna Downie resigned on 13 December 1973 and was replaced by Roger Woodford. He resigned on 27 September 1977 when Stewart McColl was appointed as a director with responsibility for sales. Frank Stott was appointed on 27 April 1978 in place of Campbell Downie and was managing director until 31 October 1998. He remained a director until 22 January 2004. Peter Marshall was managing director from 12 October 1998 until he resigned on 1 October 2000.

ICL Plastics owned about 83% of the shares in ICL Tech. The minority shareholder in ICL Tech was Frank Stott who held 17% of the shares. Campbell Downie also held a minimal shareholding.

On 19 August 1999 the company changed its name to ICL Tech Limited (ICL Tech). At the time of the disaster, ICL Tech employed 33 people.

Stockline Plastics Limited

Stockline Plastics Limited (Stockline) was also incorporated on 26 November 1973. Its main function was to stock and distribute all forms of plastic, acrylic, polystyrene, polythene and other similar materials. In 2004 its main operations were conducted in the warehouse building adjacent to the main building.

Campbell Downie and Stewart McColl were both appointed directors of Stockline in January 1973.

The offices for ICL Plastics and ICL Tech were in the main building at Grovepark Mills in which ICL Tech carried out its industrial processes.

The directors of companies in the ICL group as at 11 May 2004

As at 11 May 2004, Campbell Downie was semi-retired chairman and non-executive director of ICL Plastics, Stewart McColl was the sales director, Margaret Brownlie was the finance director and Lorna Downie was the personnel and company secretary. Ronald Ferguson was a director but had no management role at any time. Stewart McColl was the managing director of ICL Tech.

The directors were paid a salary and could hold up to 25% of the shares in their company. Salaries were set against what each company could afford to pay and remuneration fluctuated

accordingly. There were no mechanisms to award directors' bonuses.

The ICL Plastics group was self-financing and had no borrowings.

Campbell Downie

Mr Downie took semi-retirement from ICL Plastics in the mid 1980s. From then on his main function was to provide financial and strategic guidance to ICL Plastics.

The financial management of the companies was tightly monitored. Mr Downie developed a funds flow system of financial accounting to allow his fellow directors to see exactly where each company stood on a month to month basis.

In the early days Mr Downie spent about a third of his time on the ICL premises. His visits became more irregular from the mid 1980s as the ICL Group expanded and he had to be away from Glasgow more frequently. Following his semi-retirement, he left the day to day running of the operating subsidiaries to the individual directors and rarely worked on the premises. From the 1990s onwards he met with Margaret Brownlie at ICL's office once or twice a week to discuss finance, IT programme development and related matters.

Although semi-retired, Mr Downie was regularly consulted by directors of both ICL Plastics and ICL Tech in relation to any decisions that were financially significant.

Mr Downie did not regard himself as having the ultimate control and responsibility for the operating decisions for ICL Plastics, ICL Tech or any of the other subsidiaries. He described

the ICL company structure as flat rather than hierarchical. The directors of each subsidiary made their own decisions. At board meetings Mr Downie presided but did not exercise a vote except if there was disagreement between the directors. As chairman, he had a casting vote.

Part 5

Chapter 9 – The history and the layout of the Grovepark Mills site

The premises at Grovepark Mills

The Grovepark Mills building was situated in an area bounded by Hopehill Road, Grovepark Street and Grovepark Place. There were three buildings on the site: the main building, also referred to as the mill building, the fabrication shop, and the warehouse building at Grovepark Street occupied by Stockline from which the retail plastics business was conducted.

The premises at Grovepark Mills were owned at the time of the disaster by ICL Plastics, and were operated by two of the subsidiary companies, ICL Tech and Stockline. ICL Plastics first occupied the site in 1969. Two parts of the site were sold to Gael Paints and Milne Builders.

On 11 May 2004, 66 persons worked at the premises.

The history of the main building

The main building had been used as a textile mill and later as a paper mill. It was a four-storey brick structure which had been built in or around the 1860s on an L-shaped plan and added to and altered since. It originally had an open pit partly below ground level and an adjoining basement. In 1980 the open pit area was covered over by the creation of a freestanding floor. This extended the existing ground floor to form the despatch area. Since the ground floor was above the external ground level, the despatch area was reached by way of a ramp from the yard. I describe the yard in greater detail elsewhere in this report.

Structure of the main building

The first, second and third floors of the main building were made of timber supported on a grid of cast iron columns. The floors were

located on timber trusses supported internally upon the columns which ran east-west along the centre line of each floor carrying transverse timber beams. The columns were thinner on the higher floors because they carried less load. The ends of the transverse beams fitted into the walls. Floor joists were laid on the transverse beams at right angles. They fitted into niches in the beam ends.

The top of each column had a spigot which fitted into the lower end of the column above. The spigots were part of intermediate bearing saddles sitting on the columns beneath, through which the transverse beams passed. The structure was held together by gravity and by the spigots. The main building originally had a double pitched roof which was later replaced with a flat roof in the 1970s.

On each floor, the space was divided by non-structural partitions. Access to the upper floors and the area below ground level at the west end of the building, near to Grovepark Place and Hopehill Road, was by way of a stair tower that had been added to the building in about 1907.

Use of the main building at May 2004

As at May 2004, one third of the ground floor served as a despatch area and two thirds housed the coating shop where plastic coating was applied to metal components. There were six ovens in the coating shop, four electric ovens and two gas ovens.

The two gas ovens were fuelled by LPG and natural gas respectively and were in daily use. These ovens were operated by ICL Tech.

The despatch area was used for the packaging of goods for delivery and the processing of goods received at the factory. The first floor of the main building was used mainly for storage by ICL Tech. It had a variety of store rooms and other equipment including CNC milling and grinding machines. The second floor was occupied by ICL Plastics, ICL Tech and Stockline. It contained the personnel offices, training room, computer rooms, accounts department and board room. The third floor was used for light storage by ICL Plastics and ICL Tech.

The basement below the despatch area created from the open pit was used partly by ICL Tech for the storage of components that were no longer in use, but primarily by Andrew Galloway and Kenneth Murray for storage of building tools, equipment and materials. They had been employed by ICL Plastics since around 1987 as handymen, mostly doing maintenance work. The ceiling of the basement was the steel plate that formed the floor of the despatch area.

In the basement there was a fireproof store that Andrew Galloway and Kenneth Murray had built around 1996-1998. In the area of the fireproof store there was reinforcement of the steel ceiling. Between the steel beams that supported the steel ceiling there were concrete lintels. These were cemented onto the beams on the underside of the steel floor.

There was an opening between the ground floor and the basement through the steel floor where the base of the shot blasting machine, located in the coating shop, extended into the basement. Occasionally access to the basement was required to clean and repair the machine.

History of the fabrication shop

Some years before the explosion ICL Plastics acquired on behalf of ICL Tech a modern, rectangular single-storey portal-framed steel structure with an asbestos sheeted roof and external brick wall panels to the north of Grovepark Mills. It was then known as The Scooter Centre. It had about two-thirds of the area of the main building. ICL Tech moved its fabrication operations into it from the first floor of the main building.

The fabrication shop was where the shaping, drilling, cutting and welding of plastics and metals took place. Wood was also cut to make moulds, jigs and frames. A wide variety of machinery was used to perform these functions. The fabrication shop was accessed from the back yard security door. At the entrance there was a receiving area for stock and materials. There was also a cabinet there which stored various chemicals. There were two electric ovens in the fabrication shop.

The only LPG that was used in the fabrication shop was in a flamer that worked off a propane bottle. The bottle was kept in a cubicle. It was used about once a week for about an hour. It was not used on the day of the explosion.

History of the Stockline warehouse

At the time of the disaster, Stockline occupied the warehouse next to the main building on a lease from ICL Plastics. ICL Plastics had bought this from John Russell Joiners on 27 February 1981. This building survived the explosion.

The main business of Stockline was the storage and sale of bulk plastic sheeting. The warehouse had a small amount of machinery

for cutting and altering sheets of plastic to customers' specifications. At the time of the disaster, all of the Stockline office staff worked in the main building.

The yard

To the south side of the main building was a triangular shaped yard. A bulk storage tank for LPG was located there at a distance of about 15.5 feet from the building. The tank was connected to the underground pipe running beneath the yard that I have already described. This pipe originally rose to enter the main building above ground through a bricked up window into the open pit area. To counter problems with flooding, the level of the yard was raised in 1973. As a result, the LPG pipework was covered over where it entered the building. I refer to this in greater detail elsewhere in this report.

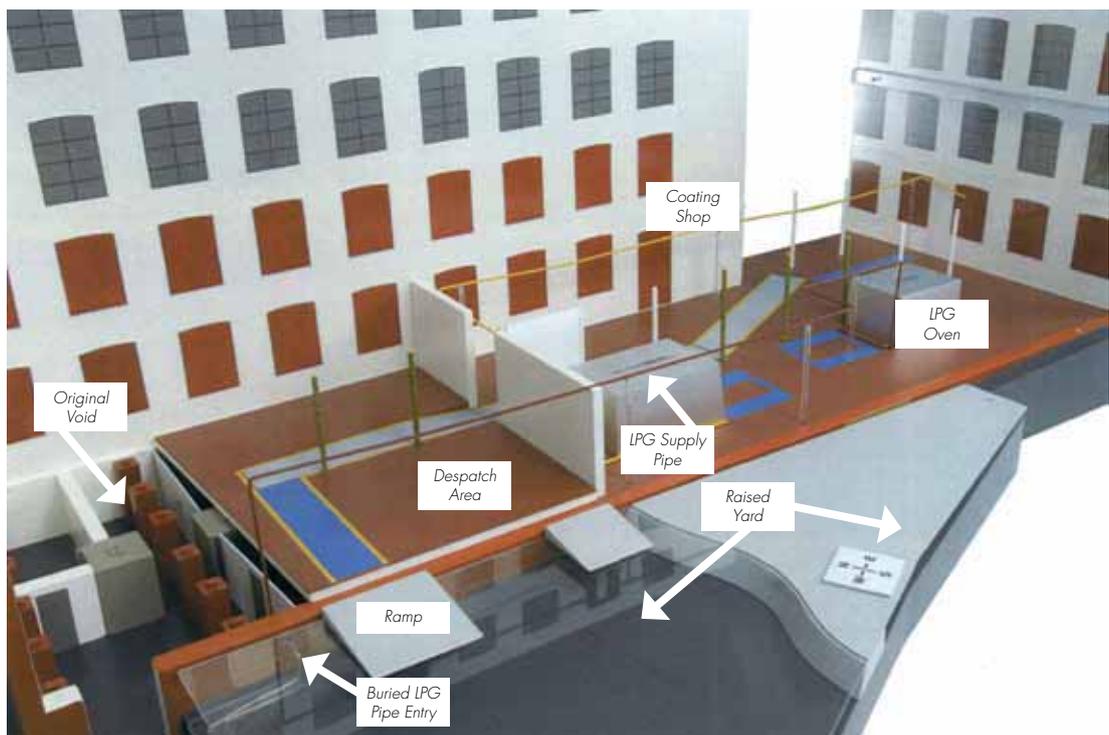


Figure 25 – Model of the Grovepark Mills premises

Chapter 10 – Calor and Johnston Oils and the installation at the site

LPG was supplied to the Grovepark Mills site by Calor Gas Limited (Calor) between 1969 and 1998 and by Johnston Oils Limited, trading as J Gas, between 1998 and 2004.

Calor Gas Limited

Calor have been one of the major UK national suppliers of LPG since the fuel was first used and have been supplying bulk tank installations since the mid 1950s. Calor have played an active part in setting technical standards. They have a substantial technical department.

It has not been possible to ascertain the precise events and procedures followed at the Grovepark Mills premises. Calor's general practice is as follows.

Standard installation procedure for all premises

Contracts are generally arranged by sales staff who have knowledge of tank location and installation requirements but no in-depth technical expertise. Technical queries are passed to the technical department. During the initial detailed discussion with the prospective customer, the salesman would establish the purpose of the LPG installation; whether Calor was being asked to supply any appliances; and how much of the pipework, including pressure regulators and isolation valves, the prospective customer wished Calor to supply and install.

The contractual arrangements made between Calor and the customer would determine the responsibility for installation and maintenance. Normally, any part of an installation beyond, or downstream of, the vapour off take valve, would be the customer's responsibility. This would mean that the first stage regulator, its fittings and all pipework between the first

stage regulator and the appliances within the premises would be the responsibility of the customer.

This would all be set out in the initial contractual documentation.

To calculate the size and number of the tanks required, and the size of the pipe required, it would be necessary to consider a number of factors including the exact locations of the appliances, the gas input capacities of the appliance burners and their burning pressures, the pipe-run distances from the appliance to the point of entry into the building and from the building to the storage tank, and to allow for a minimum four weeks supply in the tank based on usage.

In accordance with regulations, the tankage would have to be sited at a set distance from the nearest building, boundary, property line and any other fuel sources. There would have to be adequate access for the vehicle delivering the tank, for the tanker and for fire service vehicles. The siting distances of tanks and other associated requirements are laid down in various Health and Safety Executive publications. The prospective customer and the salesman would then agree on the position of the tank site.

The salesman would then sketch the installation and price the work agreed. The salesman would produce a specification and list of materials, and a contract. On agreement and acceptance of the proposal by the customer, a contract would be completed and signed.

The Sales Force Manual prepared by Calor provides sales staff with instructions that they

are to follow. The Manual instructs sales staff to refer to the technical staff where the installation is not straightforward. Every proposed installation involves a drawing.

If Calor were to install any pipework, any related drawings would indicate the pipework route, its termination and tank location. The drawings would show all measurements. Before programming an installation, the salesman's paperwork and drawing would be checked by a member of Calor's Technical Services Department. Further checks would be carried out by the fitter installing the tank and by the tank delivery driver, both of whom would visit the site with a site drawing.

The fitting of LPG bulk installations

Calor have regional fitters who carry out LPG installations. A standard installation in non-commercial premises would comprise the tank, first stage regulator, second stage regulator if required, external pipework, isolation valve, and internal pipework to point of usage. The extent of Calor's involvement in the installation overall depends on the terms of the agreement. Calor work to HS(G)34 guidelines and to the LPGA Codes of Practice/British Standards and their own specifications. In the absence of any formal procedures and guidelines, as was the position in the 1960s, Calor drew up their own guidelines. With a new installation, safety information and an emergency service card would be provided to the customer.

For a new installation in commercial premises, Calor would now generally provide a tank and a first stage regulator and offer to install the pipework to the exterior wall of the building.

The ownership of, and responsibility for, the pipework depends on the individual contract between Calor and the customer. If the customer is required to lay pipes, the onus will be on the customer to follow the specification provided by Calor. If requested, Calor can lay the pipes.

Calor will connect to existing pipework only after inspecting and pressure testing the pipework.

Calor normally retains ownership of a tank and leases it to the customer. All other items supplied by Calor are sold to the customer. Calor would sell tanks only in exceptional circumstances. By retaining ownership, Calor ensures that the tanks are tested under their testing regime. Testing tanks is mandatory. The test dates are displayed on the tanks.

Having agreed the siting of the tank, the customer would be required to lay a solid concrete tank base of prescribed dimensions. In the case of a 2-tonne tank, this would be 12 feet by 6 feet by 6 inches. The customer would be informed of the dimensions and the route of the trench for the underground pipework from the tank base to the pipe entry point at the wall of the building. Calor would deliver the tank and place it onto the concrete base and install the vapour off-take valve on the tank and the vapour off take pipe as far as ground level adjacent to the trench where the underground pipe would be laid. The tank would be delivered tested onto the base.

To activate the delivery of a tank, the customer would notify Calor when the base had been prepared and the trench opened. If Calor had contracted to do so, the Calor fitter would install

the necessary equipment, pipe and fittings. If part of the pipework had been installed by the customer, the tank would not be commissioned for use until the Calor fitter had carried out a soundness test on the entire installation. If Calor had fitted the customer's internal pipework, Calor would normally check the soundness of the pipework in 2 stages - from the tank to the first stage regulator and from the first stage regulator to the customer's appliance. A pressure gauge would be fitted to the customer's appliance to monitor the test. Once the customer's entire installation was completed, Calor would commission the tank. Only then could the tank be filled with gas. Bulk tanks to be installed would sometimes contain 50 litres of gas to enable the fitter to carry out a pressure test and to commission the tank. A soap test of all joints would be carried out. If any leaks became apparent, these would be repaired by the tank fitter. During installation and commissioning of the system, safety signs would be located in close proximity by the fitter. Emergency contact numbers would also be provided. Thereafter, gas would be delivered to the tank.

Once the tank and pipework had been installed, the customer would be given a safety leaflet explaining the arrangements for pipework inspection. A 5-year inspection of the pipework is currently recommended, tying in with the 5-year tank inspection. This would include a pressure test. Excavation of pipework would be considered necessary only if a problem or a leak had been reported.

Periodic testing

Calor carry out 5-, 10- and 20-year tests on their bulk tanks. A 5-year test involves a visual inspection and, until more recently, a change of the pressure relief valve. No soundness test

on the pipework is carried out at the 5-year test. A 10-year test involves an ultrasonic test to measure the thickness of the metal at various points of the tank. The pressure relief valve is changed at this time. There is also a soundness test of the pipework between the tank and the emergency control valve. A 20-year test involves either an exchange of the tank or an enhanced in-service test which involves the tests carried out at 10 years and tests of the valves and pipework on the tank itself. A soundness test is also carried out. It is open to customers at any time to request Calor to carry out a soundness test of their pipework. The cost of such a test is charged to the customer.

The filling of tanks

Only Calor can fill Calor tanks. This is a term of their contract with the customer. Deliveries of gas made by Calor require the delivery driver to complete a Bulk Installation Defect Report (BIDR). If the driver has encountered any difficulties, he is required to contact Calor's emergency response immediately to have an engineer sent to the site.

Installation of LPG pipework in basement areas

Since LPG is heavier than air, Calor state that they would not knowingly connect pipework to an appliance in a basement or pit. Where it was necessary for pipework to be installed in a basement, it would not be approved by Calor unless there were appropriate safety measures in place, such as having as few joints as possible, having gas detection equipment, and having the pipe protected against mechanical damage.

Johnston Oils Limited trading as J Gas

Johnston Oils Limited (Johnston Oils) is a privately owned supplier of fuels. It also trades under the name J Gas. The company is based in Bathgate and has been trading for 40 years. Johnston Oils supplied gas to the Grovepark Mills site from 1998 to the date of the disaster.

The contract between Johnston Oils and ICL Plastics

The supply of LPG by Johnston Oils to ICL Plastics began on 22 April 1998. The terms and conditions of the supply are set out in a document dated 10 February 1998. They provided that the risk in the products delivered would pass to the buyer immediately upon delivery. Condition 3(c) provided that Johnston Oils were responsible for insurance, maintenance and testing of tanks, regulators and pipework supplied. The pipework was already *in situ* when Johnston Oils took over the supply. ICL Plastics drew up a diagram which was attached to the agreement showing where the tank was and where access could be gained by Johnston Oils' delivery vehicles.

Under the bulk supply agreement, if the customer moved to another gas supplier the pipework would remain the responsibility of the customer. Johnston Oils considered that, as new suppliers taking over an existing installation under their agreement, they would be responsible for the pipes only up to the first stage regulator. There was nothing in the UKLPG Guidelines issued at that time that affected the position. The industry practice was thought always to have been, and to continue to be, that the responsibility for pipework rested with the owner or the customer. HSE guidance was interpreted as supporting that view.

When Johnston Oils took over the supply they carried out a soundness test. Neither ICL Plastics nor ICL Tech asked Johnston Oils to inspect the pipework. If either had, Johnston Oils would have carried out a risk assessment and investigated the type of pipes being used at the site, their location and their estimated age. Given the nature of the pipework, Johnston Oils would have recommended that it be replaced. This would have been done by Johnston Oils only on receipt of a written instruction.

Johnston Oils were never aware of any problem with the pipework at Grovepark Mills. If a driver had reported any problem with the pipework downstream of the first stage regulator, he would have been instructed to turn off the gas. The customer would have then been contacted and advised to have repairs carried out to the pipework. If the customer had asked Johnston Oils Ltd to carry out the repairs, they would have done so.

Mr Alan Elliott of Johnston Oils considered that LPG pipework should not be installed in a basement or open void. He considered that if such pipework existed, it should be subject to a risk assessment. He did not know that the pipework from the tank was routed below ground into and through the basement. If he had known of this, he would have advised ICL Plastics to dig up the buried pipework because that would be the only way to establish its type and condition.

Regular inspections

Johnston Oils had a written scheme of inspection for bulk tanks. This was Johnston Oils' standard specification for all installations.

The annual testing and inspection of the valves and fittings of a tank was a common practice. Johnston Oils issued their drivers with a checklist, which was returned to the main Johnston Oils' offices once tests had been completed. If a leak was identified, the normal practice was that the delivery driver contacted Johnston Oils' headquarters.

Past practice dictated that at every 5-year examination the pressure relief valve would be replaced. Research carried out by Calor in conjunction with HSE concluded that the reasonable life of the valve was 10 years. As a result the industry changed its practice to replacement every 10 years rather than every 5 years. The replacement of the valve had nothing to do with the integrity of the tank itself. After 20 years the tank would be refurbished.

Johnston Oils' tanker drivers carried out annual inspections of the bulk tank on 8 August 2001, 10 June 2002 and 9 June 2003. The tank would have been inspected and the valves and fittings leak tested, but there was no testing of the pipework. There was no indication that a 5-year examination of the tank was carried out.

Other circumstances relating to the LPG installation at Grovepark Mills

At some point before the disaster, two additional 47 kg LPG cylinders were fitted to a branch in the pipework which led from the tank to the first stage regulator. They provided back-up if the LPG in the tank ran out. It is not known who fitted those cylinders. The presence of these cylinders did not play any part in the causation of the explosion.

Chapter 11 – The installation of the LPG tank and external pipework

The Original LPG installation

In 1969 Campbell Downie, on behalf of ICL Plastics, concluded an agreement with Calor for the purchase of bulk supplies of LPG for the LPG oven and for the hire of a bulk storage tank.

On 29 May 1969, Mr J V Halhead, contracts manager of Calor, wrote to ICL Plastics with a quotation for the hiring of a 2-tonne LPG tank. Mr Halhead said, *inter alia*:

“It is noted should our quotation be acceptable to you, the galvanised iron pipe, pipe fittings, et cetera, required to connect from the two ovens to the bulk propane supply should be carried out by your own labour force.”

The quotation offered:

- “(a) one type 2-tonne capacity bulk propane storage vessel on outright purchase for the next sum specified or, alternatively,
- (b) one type 2-tonne capacity bulk propane storage vessel on annual hire at a rate per annum which is specified.”

The notes to the quotation specified that “it would be the customer’s responsibility to excavate and subsequently infill a suitable trench to accommodate the high pressure pipeline from the Bulk Storage Vessel to the main building.”

There is no evidence that any Calor representative saw the trench or the pipework before it was backfilled. Had a Calor representative noted any problem with the installation of the pipework, it is likely that he would have reported that to Calor and that Calor would have written to ICL Plastics asking them to remedy the problem.

On 15 December 1969 Calor wrote to ICL Plastics indicating the correct siting of the tank. A Calor plant and equipment hire proposal form dated 16 August 1969 showed that the hirer was ICL Plastics. The document detailed the supply of one 2-tonne liquid LPG capacity tank, serial number 260458. This serial number most likely related to the original single 2-tonne tank that was installed at the ICL premises. It is likely that Calor provided to ICL Plastics a leaflet that included safety information and contact details in the event of an escape of LPG. It is also likely that if ICL Plastics had indicated that they intended to arrange for the laying of the pipework, Calor would have provided a specification and a method of working for the installation. No evidence of any such leaflet or specification and working method has been found. There has been no evidence available to the Inquiry as to whether or not Calor was consulted on these points.

The agreement with Calor expressly stated that ICL Plastics carried the responsibility for installing and designing the pipework from the pressure regulator to the oven.

Calor received a letter dated 17 December 1969 from ICL Plastics confirming that “our installation conforms to the necessary precautions for tank installations.”

In due course Calor installed a 2-tonne LPG tank.

A building warrant would not have been required for the creation of the LPG installation, including the tank and the pipework.

The original contract was between ICL Plastics and Calor. Invoices for the supply of LPG

were rendered to and paid by ICL Plastics. ICL Plastics then re-charged these costs to ICL Tech.

When first installed, the main length of the LPG pipework was about 0.3 metres below the surface of the yard. It was galvanised but otherwise unprotected. The final section of pipework at the outside of the main building rose vertically to about 0.45 metres above the original surface of the yard before passing by way of a right-angled bend horizontally into the building. The section of LPG pipe that entered the building was therefore clearly visible.

The pipework entered the building through a bricked-up window into the original open pit area within the building. It was therefore also visible in the pit area. This open pit area later became part of the basement. The pipework was not sleeved or sealed where it passed through the bricked-up window and entered the open pit.

After the disaster tests with tracer gases demonstrated that there was a leakage path below the pipe entry point. It has not been possible to determine exactly the path by which the LPG entered the building through the basement wall.

Where the pipework entered the open pit area, there was a shut-off valve that controlled the flow of gas into the premises. It was used in earlier years to turn the gas on and off each day. In later years, when Johnston Oils were the suppliers and the tank had been replaced, this arrangement was changed. The LPG supply was isolated at the external isolation valve located at the tank. Access to the basement for this purpose was no longer required and the valve in the basement remained open.

From the shut-off valve in the basement the pipework travelled up to the ceiling of the ground floor and ran along the length of the coating shop, bracketed onto the ceiling beams, to the LPG oven.

The installation of the LPG pipework

ICL Plastics engaged Grieben Plant Limited to supervise the installation of the underground pipework by a subcontractor. The identity of that sub-contractor is not known. The principal of Grieben Plant was the late Frank Semple, a former marine engineer who was Campbell Downie's brother-in-law. It is not known whether Grieben Plant had any experience in the laying of underground gas pipes. The specification for the installation, if it existed, has not been found.

Between the installation of the buried pipework in 1969 and the disaster in 2004, ICL Plastics remained the heritable proprietor of the land in which the pipework was buried. From their incorporation in 1973 until the disaster in 2004, ICL Tech were the occupiers of that part of the premises in which the LPG oven was situated and used the gas that was supplied through the buried pipework.

The raising of the yard

In 1973, because of problems with flooding and drainage in the yard and the need for a vehicular access from Grovepark Place, ICL Plastics decided to raise the level of the yard. The other proprietors on the site agreed to this. At their own suggestion, Alex Milne & Son, Builders carried out the works. Campbell Downie's only involvement in the raising of the yard was to pay for it and to complete the application for a building warrant.

The yard level was raised by about 1.1 metres using rubble infill which was covered with concrete hard standing. The riser for the LPG pipework became buried in the hard core and under the concrete hard standing.

This work brought the level of the yard to about 0.6 metres below the level of the ground floor of the building.

A copy of an application form dated 4 January 1973 for a building warrant to raise the level of the yard was found among the rubble. It was completed by ICL Plastics. The works applied for were described in the document as 'Levelling Access, Drainage at our yard at Grovepark Place'. The application was signed by Campbell Downie. At the bottom of the application form it was indicated that the Scooter Centre, the then owner of the fabrication shop building, and Mr A J Milne on behalf of Alex Milne & Son had accepted service of the application.

The application was granted by decree of the then competent authority, the Dean of Guild Court. The Senior Archivist, Culture and Sport, Glasgow confirmed to the City Council that no trace of any drawing or other technical information supporting the application could be found. These works may also have required planning permission should they have impacted on drainage provisions.

Without the specification or plans submitted in support of the application for the warrant, it cannot be known whether the presence of the LPG pipe entering the building was noted; nor whether the work was carried out with any technical advice. It seems that no thought was given to the existence of the LPG pipework or to

the potential consequences of burying the riser in this way.

When the riser to the building became encased in rubble and earth and covered with concrete, it became invisible at the point at which it entered the building. Internally, the pipe remained visible and accessible; but when the open pit was later covered over by the steel floor of the despatch area, the LPG pipe became invisible.

Campbell Downie's enquiry about pressure in the LPG pipework

In a letter dated 13 February 1974 Campbell Downie referred to recent discussions with Calor concerning the repositioning of the tank. He enquired whether there was any simple metering equipment available to give an indication as to gas usage throughout the plant and "b) a means of confirming that tight line pressure is being maintained in the piping system." The question appears to have been raised for the purpose of avoiding waste. No further information concerning this enquiry, or its response, has come to light.

The history of the open pit area

The open pit area existed for the purposes of the manufacturing processes carried on before ICL bought the building. It extended above the external ground area. There were bricked-up windows at that level.

In the 1970s, HM Factories Inspectorate and later HSE made a series of visits to the ICL Plastics premises in connection with fire precautions. In 1975 the use of the basement area gave cause for concern. At that time, the only entrance to the pit and basement area was by the stair tower. On 9 October 1975, HSE

served an Improvement Notice on ICL Plastics requiring improvements to fire precautions, including the provision of an additional means of escape from the basement at the north west corner directly to the open air.

Although some of HSE's requirements were implemented, the additional means of escape from the basement was not installed. On 13 January 1976, HSE served a Prohibition Notice on ICL Technical Plastics prohibiting the use of a corridor adjoining the east stairway and forming part of an escape route, and another on Stockline prohibiting its use of the basement other than for the removal of material in a store and the dismantling and removal of machinery from the work room area. HSE was thereafter satisfied that the basement was no longer in use as a place of work.

In 1977, responsibility for fire safety enforcement passed from HM Factories Inspectorate to the fire service. In 1979, ICL decided to extend the ground floor level over the pit area to create a despatch area that would be level with the ramp from the yard. This was done by erecting a free-standing mezzanine structure consisting of steel chequer-plate flooring supported on lateral steel beams, in turn supported on steel columns footed on concrete plinths. The structure measured about 11.5 by 5.5 metres.

On 13 July 1979 Campbell Downie wrote to JGN Reid Brothers Limited, structural engineers, requesting a written quotation for the supply and construction of the steel floor structure. The letter enclosed a plan and a specification for the floor. On 15 February 1980, JGN Reid submitted a quotation of £3,742. ICL Plastics accepted the quotation on 20 February 1980.

When the pit was covered over, no mechanical ventilation was installed. Beams criss-crossed under the steel floor and the suspended concrete floor. Steel support pillars ran down the middle of the closed-over pit from the fireproof store to the rear. A brick pillar was built around each steel pillar to ensure that, in the event of a fire, the brickwork round the steel pillars would deflect some of the heat. Mr Downie instructed Andrew Galloway and Kenneth Murray to carry out the work.

A wall divided the closed-over pit from the remainder of the original basement area. It ran below the edge of the steel plated floor. It had a door giving access to the rest of the basement area. Mr Downie required steel beams to be installed between the pillars to provide support for the areas over which forklift trucks ran. There was also scaffolding supporting railway sleepers below the concrete floor. A distinctive blue paint on the concrete floor of the despatch area indicated the path for forklift trucks.

An additional steel floor structure, constituting new floor space and being an alteration within the building, would have required a building warrant even though it was a free-standing structure. It is not known whether such an application was made.

Mr Campbell Downie said that he thought that a building warrant would have been unnecessary as the floor was a free-standing structure. It was not embedded into or attached to the main structure of the four-storey building and no brickwork alterations were required to accommodate it. He said that he would have expected JGN Reid, who at that time were well-known structural engineers in Glasgow, to indicate if a building warrant was necessary.

It is unlikely that the steel floor structure would have required planning permission as it did not involve development external to the building.

While the construction of the steel floor may have reduced any natural ventilation, it did not create an unventilated void. The void already existed. In the absence of mechanical ventilation it was possible that, even with any natural ventilation available in the void, the LPG could reach a critical explosive mix, notwithstanding the presence of the steel floor. The particular significance of the introduction of the steel floor was that the LPG pipework, on entry into the building, became less visible and less accessible. It also made the detection of any leak of LPG by smell less likely.

Composition of the pipework

The sections of the pipework within the yard were galvanised steel. The fittings were whiteheart malleable iron. All but one were ungalvanised. The pipework between the storage vessel and the point of entry to the basement did not have a waterproof coating.

Before the disaster, James McGoldrick, an employee of ICL Tech, had noticed that the LPG pipework above the batch oven had changed colour. A colleague told him that this was because of corrosion. He knew that the company was attempting to get quotations to have this pipework replaced. Gordon Bell recalled that the quotations were for the replacement of LPG pipes within the coating shop that had come free from their fastenings above the LPG oven. So far as he knew, one quotation had been received in February or March 2004. It was in the possession of William Masterton. The company was awaiting a second quotation.

Operating procedure

Each day an employee, usually James McGoldrick, would open the coating shop/despatch area and switch on the machinery and ovens. He would turn on the gas supply to the LPG oven at the shut-off valve in the basement, light the pilot lights with a gas lighter and activate the burners. At the end of the working day, Gordon Bell would switch the LPG oven off before James McGoldrick turned the gas off at the shut-off valve in the basement. After Johnston Oils became suppliers the practice was to turn the gas off at the LPG tank in the yard. The valve in the basement remained open. There was also a shut-off valve in the propane supply pipe to the oven within the coating shop.

Inspections 1975 - 1988

Between 1975 and 1988, various HSE inspections were carried out at Grovepark Mills. I refer to these later. HSE repeatedly expressed concerns about the siting of the LPG tank and the storage of combustible materials in the vicinity of it. Between 1988 and 1991, various proposals and counter proposals were made on the matter.

During the period 1988-1991 Kenneth Platt, an employee of Calor, carried out a 5-year inspection of the tank and replaced the pressure relief valve.

On 3 June 1991, Calor carried out a 10-year test on the tank and certified it. A checklist within the certificate indicated that the tank had passed the requisite tests.

A Calor computer screen print and installation sheet indicated that on 17 June 1991 two tanks with serial numbers 214031 and 213648

were delivered to ICL Tech. The two 1-tonne tanks each had a 2,000-litres capacity. Calor disconnected and removed the existing 2-tonne tank. This operation could have been carried out by a Calor engineer or by a sub-contractor.

It may be assumed that the engineer who carried out the exchange carried out a soundness test on the installation and the pipework through to the first available isolation valve.

The Johnston Oils installation

On 10 February 1998, Margaret Brownlie, finance director, completed and signed a customer account application form for Johnston Oils. On the same day she wrote to Calor to tell them that ICL Plastics had entered into the agreement with Johnston Oils and to ask them to arrange a tank uplift with Johnston Oils.

On 19 March 1998 Alan Elliott of Johnston Oils wrote to Calor confirming that ICL Plastics were terminating their supply contract with Calor and seeking confirmation that the change over to Johnston Oils would take place on 25 March 1998.

On or about 25 March 1998, Johnston Oils installed a single 1-tonne tank, with the serial number S38768. Before the installation, Johnston Oils did not carry out any kind of inspection of the existing pipework, including the buried pipework, as it was a like-for-like exchange of tanks, and the existing pipework was the responsibility of ICL Plastics. Johnston Oils therefore had no knowledge as to the age or condition of the buried pipework or as to its route through the basement.

Uplift of the Calor tanks

By letter dated 16 April 1998, Johnston Oils informed Calor that ICL Plastics wished Calor's tanks to be removed by 16 April 1998. A Calor uplift request form was drawn up dated 17 April 1998 requesting that Ankor Gas uplift the two tanks that had been installed on 17 June 1991. The work order was signed by ICL Tech on 20th April 1998. On the same day the two tanks were removed.

The supply of LPG by Johnston Oils to ICL Tech began on 22 April 1988.

Johnston Oils subcontracted the installation of the tank at Grovepark Mills to IB Contracts. The installation was carried out by David Inglis who had been with the company since he was 16 years old. He was an accredited engineer with the Construction Industry Training Board (CITB). He was certified in the installation of LPG tanks and pipework. He had experience of fitting over 200 tanks.

David Inglis connected the tank to the existing pipework via the vapour off-take valve and then to the first stage regulator. After connecting the tank, he carried out a leak test on the visible section of the pipework by turning on the vapour off-take valve to release gas into the pipework, before spraying the visible pipes with a leak detector fluid. He then carried out a soundness test to ensure the integrity of the overall system. He repeated that test. The test did not indicate any loss of pressure.

The soundness test was carried out at the normal working pressure of the system. It would normally be carried out between the first stage regulator and a shut-off valve on the outside of the building where one existed.

There was no such valve at the ICL premises and, as a consequence, this test was carried out on the pipework to the valve beside the oven in the coating shop. If the soundness test had indicated a leak, David Inglis would have shut off the LPG supply, disconnected the tank and plugged the pipework. He would have informed Johnston Oils and recommended that the pipework should be replaced.

Johnston Oils assumed no responsibility for the existing pipework.

On or about 29 November 1998, Johnston Oils removed the tank that had been fitted on 25 March 1998 and installed a 1-tonne tank, serial number S14627, in its place. It is likely that the replacement was carried out by David Inglis. He would have carried out the same procedures as before.

Johnston Oils' records give no indication as to why this tank exchange took place. The most likely explanation is that the contents gauge was not working.

Johnston Oils' tanker driver, Russell Fleming examined tank S14627 on 8 August 2001. He reported that the tank was operating satisfactorily. The examination report and certificate of compliance indicated the tank had been manufactured on 29 January 1992.

On 8 April 2002, IB Contracts changed the regulator on the tank. The work was done by David Inglis. He carried out a soundness test on the system. There is nothing in IB Contracts' invoice to indicate why the regulator was changed.

Part 6

Chapter 12 – A narrative account of the involvement of HSE at Grovepark Mills

The involvement of the HSE at Grovepark Mills

The general history of HSE dealings with ICL

The Factories Inspectorate undertook a number of visits to the ICL premises between 1970 and 1975. These visits were generally recorded by Inspectors on a Report on Visits form, known as Form Fl.42. The Factories Inspectorate was superseded by the Health and Safety Executive after 1975 when the Health and Safety at Work Act came into force.

The Factories Inspectorate visits between 1970 and 1975 indicate that particular attention was paid to fire risks. The local fire authority became the enforcing authority for general fire precautions in factories under the Fire Precautions Act 1971 with effect from 1 January 1977, other than in respect of certain types of premises for which responsibility remained with HSE. The ICL premises were not within those special categories.

Between the mid 1970s and the early 1990s, the main concerns of the HSE officers who visited Grovepark Mills in so far as they related to the LPG installation centred on the size and siting of the bulk storage tank and the consequent risks.

On 16 April 1970, Mr W A Dolling, an Inspector with the Factories Inspectorate, visited the site at the request of Mr Smart, a fire prevention officer. Mr Dolling saw Mr Downie and noted that "the standard in this factory leaves something to be desired" and that "these premises are a high fire risk premises." This was followed by a further visit. An entry for 3 December 1970 records that Mr Downie was seen; that "this firm have acted speedily on

the items drawn up on the F119 of 19 June," that the only item not dealt with were sanitary conveniences for women employees and that "the firm appear to have every intention of complying with the provision of an extra toilet."

In 1971, an inspection showed that fire alarms had been fitted, that fire fighting equipment was suitably maintained, that fire exits were available and that a suitable fire routine was in place for employees. A recommendation was made to remove the premises from the high fire risk list. A note was made that suitable toilet accommodation had been provided for office women employees. A fire certificate had not yet been issued.

In 1972, there was a visit at which Mr Downie was seen. It related to a visit by the Fire Prevention Officer. An electrically operated break-glass fire alarm system was in the course of installation. A note records "No fire certificate has as yet been issued for this building which is now well maintained." The report noted that the means of escape were clear and well signposted and that the doors were openable at all times, and that the staff were clear as to what to do in an emergency, there being drills about every six months. The inspector notes that "due to the responsible attitude now being shown by management, I believe that this firm can now be taken off the high fire risk list."

All the recommendations in the Fire Prevention Officer's report had been carried out, with the exception of an item relating to electrical installations. The report noted that the firm employed a full time electrician who seemed sensible and competent. Old conductors were mostly no longer used and were being progressively replaced. The new wiring

appeared to be excellent. An accident giving rise to a complaint was noted as having been investigated. There is no trace of this complaint.

In April 1973, the Fire Prevention Officer made a complaint to the Factories Inspectorate about the occupation of a small office on the second floor, there being no alternative means of escape in the event of a fire. The original means of escape had been blocked off for some time and not re-opened. Mr Downie was informed that there was a risk of trapping and that the original alternative exit should be unblocked. The local authority was to be asked to carry out an inspection for fire certification as a matter of urgency. However, because only a small number of employees worked on the second floor and the existing means of escape were well protected, it was not considered that the matter demanded any more urgent attention.

On 22 August 1973, Mr A D Sefton and Mr John A Powell of the Factories Inspectorate visited the site. They noted that an alternative means of escape from the second floor was now available. Works were being undertaken to increase office space. Mr Downie told Mr Sefton that the Master of Works Department and Glasgow Corporation were involved and that a Fire Prevention Officer was paying regular visits. The report of the visit noted that the firm was expanding rapidly and "because of the materials used and stored, it does present a considerable fire hazard. Mr Downie, the occupier does not take a responsible attitude, especially as far as fire matters are concerned and for this reason I believe the firm should be kept on the high fire risk list." This recommendation was not followed. This is the last entry in which Mr Downie is recorded as having been seen by Inspectors.

On 1 October 1975, an inspector visited the site and spoke with Mr Woodford, managing director of ICL Technical Plastics, and Mr Wilson, electrician. The inspector noted that conditions at the premises were poor: "Conditions in this factory have deteriorated considerably. In particular, the means of escape, the storage and use of highly flammable liquids and materials, and the guarding and machinery [*sic*] gives rise to serious concern."

The report records the building as being "four storeys with a basement area at the Hopehill Road end of it. The top floor and part of the second floor are unoccupied and it is proposed to seal off the top floor in the near future. The staircases at the front and the rear of the building will make good means of escape once the partitions have been brought up to the necessary standard."

In respect of highly flammable liquids and materials, the report noted that "There is a 1½ ton LPG (propane) installation in the small yard at the side of the building, which serves the ovens and ground floor and the heating throughout the premises. Glass fibre work is carried out on the first floor and there is a spray booth on the ground floor. Also, highly flammable plastics are stored and used throughout the premises. All these matters give rise to serious concern." This was the first recorded note by HSE as to the presence of the LPG installation on the premises. The report noted that guarding was required for nearly all the machines.

A report of a joint visit by an inspector and fire prevention officers on the same day records that "since my visit earlier in the day a considerable

amount of effort had been put into tidying up the place. Most of the rubbish had been removed and most of the machines had been put out of use." The highly flammable liquids had been collected and a covered skip was due to be delivered. While the fire officers were concerned about the means of escape, they did not consider there to be an immediate risk. The firm had agreed to stop all work in the basement area and to improve the means of escape from the corner of the ground floor where spray painting and coating processes were carried out. A subsequent visit was made on 3 October 1975 with a fire prevention officer and building control officer to ensure that the required alterations to the means of escape would meet building control standards.

After a report from Strathclyde Fire Brigade, Mr Powell visited on 9 October 1975 and delivered to Mr McColl and Mr Woodford an Improvement Notice (22/247/75) in connection with the means of escape. This required that the partitions for the west and east stairway should be constructed from materials with a fire resistance of at least one hour; that the lift shaft should be totally enclosed with similar materials; that the plant room should be totally enclosed likewise; that the basement should have a new exit to the air at the north-west corner, that the alarm system should be extended and that additional lighting should be installed to the fire exits. This was an improvement notice because the fire authority did not consider these matters to be of immediate concern. The notice was served on ICL Plastics Limited as employers and as owners. It required remedial action by 9 January.

Mr Powell visited the site again on 14 October 1975 to serve six improvement Notices on ICL Plastics, ICL Tech and Stockline in connection

with heating and decoration of staircases and workrooms. The heating was described as being provided by LPG gas fires. There was concern that these presented a fire hazard. There was also concern about fumes. The provision of heat was assessed as inadequate. The file was marked to be brought forward in January for a check visit.

The check visit took place on 13 January 1976. Mr Powell attended with a fire prevention officer. They saw Mr Woodford. They noted that only a few of the various works specified in the schedule to the Improvement Notice had been carried out and that the means of escape still gave rise to concern. Other fire prevention officers attended and saw Mr Woodford and Mr McColl. Mr Powell then issued three Prohibition Notices, 1, 2 and 3/247/76, to ICL Plastics Limited; ICL Technical Plastics Limited and Stockline Limited respectively. The Prohibition Notice on ICL Technical Plastics Limited was immediate. It related to the use of a corridor that was part of a means of escape. It did not refer to the basement included in the original Improvement Notice 22/247/75. The Prohibition Notice on ICL Plastics was a deferred notice giving 28 days until 10 February 1976 in which to bring the means of escape up to standard and related to the "use of the premises at Grovepark Mills as a place of work" as "safe means of escape in case of fire have not been provided for all persons employed in the premises."

The Prohibition Notice on Stockline Limited related to the use of the basement as a storeroom and/or workroom and had immediate effect. The Notice did not apply to persons authorised to go into the basement to remove the remainder of the material in the store

and to dismantle and remove the machinery from the work room store. This was to permit the closing up of the basement. The prohibition was to continue until an adequate means of escape from the basement was provided. In the event the basement ceased to be used as a place of work. Mr Powell's evidence was that a Prohibition Notice was not supposed to last in perpetuity. Once the requisite remedial works had been complied with, it would cease to have effect. After 1 January 1977 responsibility for fire precautions passed to the Fire Authority, other than in certain specialised cases. ICL was not one of those cases.

Another visit followed on 13 January 1976. The file records that Mr McColl had taken over responsibility for the building and for other health and safety matters. The purpose of the visit was to collect evidence for a prosecution in respect of Improvement Notice 22/247/75 served on ICL Plastics Limited on 9 October 1975. HSE sent a report to the Procurator Fiscal in Glasgow proposing prosecution in light of the failure to comply with the Improvement Notices to provide a proper fire escape. In a letter to the Procurator Fiscal, John Powell described Mr Downie as having an irresponsible attitude in connection with fire matters.

A further visit took place on 23 January 1976 at the request of Mr McColl. Mr McColl gave an assurance that action would be taken on the Prohibition Notices and was in hand on all matters. It was noted that the work in relation to the means of escape from the corridor, the subject of the deferred Prohibition Notice, was well in hand and that it appeared that it would be complied with. It appears that Mr Powell was satisfied that the basement was no longer in use.

On 10 February 1976, Mr Powell visited with fire prevention officers and found that the deferred Prohibition Notice relating to the corridor had been satisfactorily complied with. He noted that there had been "a dramatic change of attitude by the management of this firm. The threatened prosecution and closure had the desired effect and according to Mr McColl, the necessary work to comply with the outstanding Improvement Notices and other matters requiring attention is in hand". He noted that the standard of guarding on the old machinery was poor and gave advice about bringing it up to standard.

Mr Powell passed his prosecution report to the Procurator Fiscal. In it he said that "A Mr Downie is the Chairman of Directors of ICL Plastics Limited and he has consistently shown an irresponsible attitude in connection with fire matters (see form 211, 22nd August 1973). He has refused to see both myself and the Fire Brigade and he delegated his duties, first of all, to Mr Woodford and then to Mr McColl, Director of both ICL Plastics Limited and Stockline Limited". He now added a note: "Mr McColl outlined his proposals in connection with the outstanding Improvement Notice and other matters requiring attention. The management's change of attitude is amazing. They are a little embarrassed that it has taken the Factory Inspectors to turn a slum into a factory." He made a recommendation that the proposed prosecution should not proceed in view of the steps that the companies had taken. The Procurator Fiscal accepted this recommendation.

Campbell Downie regards these circumstances as demonstrating that health and safety matters from at least as early as the mid 1970s had

been accepted by subsidiary directors as their responsibility within each company. My views on Campbell Downie's role are expressed elsewhere in this report.

On 17 February 1976, Mr Powell served a further Improvement Notice on ICL Plastics Limited as owners of the buildings in respect of a lack of an escape route from premises at the rear of the building occupied by a printer, Mr Forsyth.

In April 1976, a further visit was made at the request of Mr McColl to discuss the Improvement Notices. Stockline had completed its redecoration. Both ICL Plastics Limited and ICL Technical Plastics had completed some works and requested an extension for the remainder. Mr Forsyth was due to finish work on 16 April. ICL Plastics Limited requested an extension of time to allow him to remove machines and materials. The report noted: "Although they are now trying to deny all legal liability towards Mr Forsyth and the property, they do not deny ownership of the building which is occupied by Stockline Plastics as well as Forsyth Printers. A deferred Prohibition Notice would be issued."

A further visit took place on 27 May 1976. It was recorded that Mr Forsyth had left the premises, that the Prohibition Notice in that respect had been complied with and that one of the Improvement Notices relating to decorations had been complied with in full.

A visit on 3 June 1976 confirmed that decorations required under the Improvement Notices and the machinery guarding had received satisfactory attention. Heating remained the only outstanding matter. It was

noted that "Both the premises and the attitude of management have undergone significant changes in the last 6 months. These changes have been for the better and the working conditions are at last acceptable. The changes have affected the employees who appear to be more safety conscious." This change appears to have coincided with Mr McColl's taking over responsibility from Mr Woodford. The questions about the occupation of part of the premises by the printer, Mr Forsyth who was not connected with ICL, had been resolved by his vacating the premises.

John Powell carried out a follow-up visit on 17 September 1976. While not entirely satisfied with the work carried out, he noted that extra heating appliances had been installed and that the Improvement Notices had been complied with. His report also said that "it was also noted that a plinth has been built for the LPG storage tank and it is hoped to re-site this tank in the next few weeks."

A further visit took place with the Fire Authority on 6 October 1976 when Mr McColl and Mr Stott, "new director of Stockline Plastics", were seen. Asbestos sampling was carried out and there was a familiarisation tour for the Fire Officer.

Mr Powell's last involvement with the premises was a follow up telephone call to Mr McColl on 27 October 1976 regarding the previous visit and the asbestos sampling. Mr McColl is recorded as requesting a list of recommended masks.

The 1978 Inspection Visit recorded that there had been a meeting with Mr Woodford and Mr Stott and that the premises were "maintained

in a clean but not particularly orderly state"; that Mr Stott had informed the Inspector that it was hoped to move the factory into more suitable premises within the next two to three years, and that to facilitate this it was hoped to develop an adjacent empty site. The offices were noted as "spacious and providing a good standard of accommodation."

In 1980 there was a visit to investigate an accident involving an injury from a circular saw. There was also a planned special visit to examine the extraction system. It was noted that there was a new paint spraying booth with a good level of extraction. It was proposed that there be no further action. A request was made by ICL shortly after this visit for HSE to talk to safety representatives and interested employees on health and safety in general and in particular in respect of wood working machines regulations. It was noted that the following discussion was fruitful and that "management's attitude in this firm is obviously improving. The lecture was given as part of the firm's own series of health and safety items following a number of minor accidents in this firm. I believe this firm's attitude towards health and safety is now very good."

In February 1981 a visit was made to investigate an injury sustained from the use of a cutter board. Several deficiencies in machinery guarding were noted. Guards were not being used. According to the HSE file, "While this firm maintains that it relies largely on supervision and training to ensure safety in the use of their machinery, a band saw was noted in operation with the guard hopelessly out of adjustment and the foreman was noted to walk past this without commenting. A general discussion on machinery safety followed. Management

showed concern in safety but I do not feel that this concern has yet been effectively translated into action".

The next reference to the LPG tank was on 11 June 1981. John Ives, then a Principal Inspector Training Officer, visited the premises of ICL Tech together with Sue Johnston, then a trainee inspector. Mr Ives had accompanied her to observe and assess her performance. It was a check visit to check the guarding on circular saws. Nothing had been done since the visit earlier in the year. They met Frank Stott, managing director, and Ian McAlpine, the production manager at ICL Tech. The company argued against the use of guards for the machines in question. Eventually it was agreed that wherever possible guards would be provided and used. If guards were impossible, then jigs were to be deployed. It was made clear that should any employee have an accident on an unguarded machine, it would not be taken lightly and might result in legal action against the company.

The penultimate paragraph of Ms Johnston's entry on the Reports on Visits form referred to the bulk tank:

"Also during the visit a tank containing propane (probably 2 tons) was seen within the premises. Material and equipment, including smaller LPG cylinders were being stored too close to the larger tank. The company were advised on this."

Sue Johnston wrote on 16 July 1981 to ICL Plastics Ltd, with a copy for employees. She made recommendations concerning circular saws and the woodworking machine regulations. She recorded seeing scraps of

wood and small LPG cylinders stored in close proximity to the tank. She said that these should be moved immediately and stored outside minimum separation distances.

The letter informed ICL that a further visit would be paid to ensure that this had been dealt with. The letter recommended that the company should calculate the separation distances for the LPG tank and compare this against the appropriate separation distances given in the tables in Guidance Note CS5 *Storage of LPG at Fixed Installations*. The CS5 Guidance indicated that minimum separation distances to boundaries, buildings and properties were necessary to ensure that ignition sources were kept away from the tank. Ms Johnston suggested that if ICL Plastics discovered that their tank was sited too close to any boundary, building or property line, if at all possible it should be moved and re-sited so that the correct separation distances might be obtained. If the premises were too small and it was not possible to re-site the tank, they were to contact her for further information and advice. They were requested to advise her within two months of the action that they proposed to take in relation to this.

On 10 October 1981, Ms Johnston visited the premises at ICL Tech alone to carry out a check visit on the storage of materials around the bulk tanks. Stockline Plastics had moved out and most of their material had been cleared from the yard; but there was still a problem about the siting of the tank. She expressed concern that the yard was cramped and that the separation distances between the tank and the boundary walls were “nowhere near” that required by CS5 (May 1981) and LPGA Code of Practice Part 1 (1978).

Ms Johnston also referred to concern about the filling of the tank from bulk road tankers. She made a request on 23 November 1981 for specialist input from the Field Consultancy Group (FCG) of the HSE to see whether anything could be done to improve the location of the tank.

In consequence of that request, Ms Johnston visited again on 20 January 1982 accompanied by Mr (later Dr) Alistair Gunn, an HSE specialist inspector with expertise in fire and explosions. They met with Mr Stott. The purpose of the visit was to check on the siting of the tank.

Ms Johnston noted that since her last visit, and on the advice given, ICL had altered the filling procedure for the LPG tank which now took place with the delivery tankers parked outside the yard. She also recorded that “Mr Gunn agreed that this was probably one of the worst sitings of an LPG tank that he had ever seen. I propose to write to the company with the recommendations that Mr Gunn makes in his report.”

Ms Johnston’s evidence was that if Dr Gunn had thought that there was imminent danger of any kind, he would have said so, and she would have then considered formal enforcement action.

Dr Gunn became aware that some of his recommendations might impinge on access to the tank by the Fire Brigade. Consequently, a further inspection was undertaken on 2 February 1982. Dr Gunn and Ms Johnston attended together with a fire prevention officer in order to obtain an opinion on the point. Mr Stott was away at the time of this visit. They spoke to Mr McColl.

Following those inspections, Dr Gunn wrote a report dated 8 February 1982 making several recommendations which, if carried out, would achieve an acceptable installation although it would not comply fully with Guidance Note CS5. The tank could not be sited so as to achieve the recommended separation distances. His first reaction was that the tank should be removed. However, in his evidence to the Inquiry, Dr Gunn indicated that he thought that this referred to relocation rather than removal. He noted that the adjoining wholesaler's yard was 1.5 metres lower than the factory yard and that at its lowest point about 3 metres from the tank there were drains. The existing small wall along the boundary would prevent a liquid spill into the lower yard and act as a vapour barrier or diversion.

Dr Gunn's recommendations were that a radiation wall should be built adjacent to the tank. Although this would reduce the ventilation in the area, he could see no alternative. The building of the wall would make it less easy for the Fire Brigade to put cooling water on the tank if a fire were to occur nearby. He recommended that a water drench system should be installed for the tank. A major concern for LPG storage is a Boiling Liquid Expanding Vapour Explosion (BLEVE), caused by the overheating of the liquid pressurised contents of the storage vessel. The water drench system was intended to consist of a water supply to a series of sprinklers, which would be activated in the event of fire. A drench system can be automatic or manually operated. Dr Gunn recommended a manual system.

On deliveries, the road tanker was to be outside the factory yard and under the supervision of an employee trained in the storage and handling of LPG and in the steps to take in an emergency.

There was to be an earthing point provided for the road tanker, and strict control exercised over activities in the yard during the delivery process. Extinguishers were to be provided by the tank and there was to be no combustible material within six metres of it. The security covers were to be secured. Dr Gunn made a note that as the tank was over ten years old, there should be a check that it had been recently thoroughly examined, internally and externally.

Dr Gunn said that at the time he would have had the current LPG ITA Code of Practice and the HSE's then guidance note CS5, and that he tended to use the industry standards more than the HSE guidance. The industry standards were more generally referred to. His practice would have been to show the relevant requirements to the duty holder when discussing what he would recommend.

Dr Gunn said that the request to him for specialist assistance related to the siting of the bulk installation. It was not part of the request to consider what happened once the LPG entered the building. Consideration of the underground pipework did not arise from his remit or from the circumstances of his visit to the site. The visible pipework did not appear to have any construction, support or maintenance failings. Consideration of that too was outside his remit.

Dr Gunn was aware of HSE internal circular FIC 286/43 - *Underground pipes conveying LPG*. This FIC described the recommended standards for the installation, commissioning and inspection of underground pipes conveying LPG primarily in liquid form, but it said that "similar standards could be applied with advantage to underground pipes conveying LPG vapour." It said that

“For convenience LPG is often supplied to the relevant process via underground pipes. These pipes have often been laid in an earth trench, not always protected by lagging and/or wrapping tape and covered with sand. At least four such installations are known to have failed, resulting in the release of substantial quantities of gas. In one case, an explosive concentration was created in a cellar 400 metres from the leak and such concentrations have also occurred in cellars, drains, wells, electrical mains conduits and other underground cavities... In all cases the leak has been caused by corrosion from outside the pipe as LPG itself is not corrosive. Protective coverings have been penetrated by sharp stones, particularly under the influence of vibration from overhead traffic, and corrosion has eventually penetrated the pipe wall. A resulting leak may not be discovered for a period of weeks or months.”

FIC 286/43 further recommended that after five years an annual pressure test should be carried out and that after ten years all underground pipes carrying LPG should be uncovered and physically examined, if reasonably practicable, or otherwise should be surveyed annually, the survey to include a pressure test. FIC 286/43 recommended that firms with inaccessible pipes, or pipes not installed to modern standards, ought to be advised of the danger from leaks and encouraged to install pipes to a good modern standard. Mr Tyldesley, a specialist inspector who subsequently visited the site, confirmed that this was an internal circular of HSE, but, being a technical one, would usually have been shared with the major suppliers before it was published. He did not know if this had been the case with this document. FICs were primarily for general inspectors but were also available to specialist inspectors.

The underground pipework at the Grovepark Mills carried LPG in vapour form; but the circular noted that the recommendations could be applied with advantage to pipework carrying LPG in vapour form. Dr Gunn knew of this and of the risks associated with the corrosion of underground LPG pipes and the collection of leaked LPG into voids, trenches, basements and other underground areas. He was aware that the LPG tank and pipework at the premises were over ten years old but in the course of his inspections on 20 January and 2 February 1982 he did not consider the buried LPG pipework between the tank and the building as it did not form part of the request for his assistance. Consequently, he made no recommendations regarding it. Dr Gunn accepted that if he had realised that the pipework went into a void, he would have considered the implications of this. He said that had no reason to do so since all that he saw was the pipe going off from the tank and through the wall of the building. He did not see it going underground.

Ms Johnston said that the normal process would be to lift the recommendations from the specialist's report and put them in a letter to the company, rather than to send out a complete copy of the report.

On 2 March 1982 HSE sent a letter to Mr Stott, describing him as managing director of ICL Plastics Ltd. Correspondence from Mr Stott to the HSE described him as managing director of ICL Technical Plastics Limited. The same letter was sent to Mr Sarton, the ICL workers' representative, relaying the contents of Dr Gunn's report. In the letter to Frank Stott, Sue Johnston indicated that the recommendations were of serious concern, that they should

receive immediate attention and that a further visit would be paid in three months. She further noted, in the HSE Inspection File, that a check visit was to be carried out in May 1982.

The check visit that she scheduled for May 1982 did not take place until 3 December 1982.

Mr Michael Wilcock attended on 19 November following a death on the premises that was found to be from natural causes. Mr Wilcock said that it was possible that on considering the file he had noticed that the May 1982 visit had not taken place and had put it out for an immediate check visit.

Mr Wilcock made the check visit on 3 December 1982. After it he received a call from Frank Stott, who said that the company had met all the recommendations in relation to the LPG storage contained in Dr Gunn's report. The only exception was the drench system. Frank Stott said that it had been delivered and would be installed in the Christmas shutdown period. Frank Stott is recorded as saying that he would confirm everything in writing. On 20 December 1982 he wrote to Mr Wilcock reiterating that the LPG tank had been replaced within the last 18 months; that the drench system was to be installed over the Christmas break; that all the materials were in the factory and that it was intended to operate this from a forty gallon tank high on the building running to a spray system. Details of the internal ICL dialogue between Frank Stott and Campbell Downie concerning the drench system are set out elsewhere in this report.

A subsequent note by Mr Wilcock dated 29 December 1982 stated that no further action was required.

The next relevant visit took place on 13 November 1985. On this occasion Ms Johnston was accompanied by Dr A D Scott. This visit was to ascertain ICL Tech's use of chemicals and other toxic materials. The note of the visit does not refer to LPG, but it was noted that a check visit was to be carried out in respect of the guarding, the LPG storage and the spray booths. Subsequently an unidentified handwritten note was added that this check visit should be carried out in May 1986.

On 18 December 1985 Ms Johnston wrote to ICL Plastics Ltd to confirm matters discussed during the visit. This letter referred to the Bulk Liquefied Petroleum Gas Storage and to the letter sent in February 1982 outlining the requirements for improving the LPG "insulation" [sic] and requesting ICL Plastics Ltd to let HSE know whether all the requirements had been met. The letter noted that wooden pallets and other timber were being stored immediately adjacent to the tanks; that combustible material should not be within six metres of the tank and that this had been previously brought to attention. The letter requested a reply in writing setting out the action that ICL proposed to take within the next four months on all the matters outlined. A further visit would be made to check on all the items raised in May 1986. An additional copy of the letter was enclosed to be brought to the attention of employees.

On 13 January 1986 Mr Stott, as managing director of ICL Technical Plastics Ltd, replied indicating the steps that had been taken or were in hand. In respect of the Bulk Liquefied Petroleum Gas Storage he reported that lorries no longer entered the yard; that the conductor was in place and was being used on each recharge; that they would again clear the area

around the tank but that they had not found a practical solution for spraying it. On 15 January 1986 Ms Johnston created an HSE file inspection entry that a letter had been received from Mr Stott indicating that the items brought to attention had received or were receiving attention. This note appears to have overlooked the information from Mr Stott that no practical solution for spraying the tank had been found. A handwritten note on the copy of her letter to ICL Plastics dated 18 December 1985 next to the section headed "Bulk liquefied petroleum gas storage" recorded "little done." This note was added by Alex Keddie, another inspector who visited the site.

The HSE files disclosed that the check visit proposed for May 1986 did not take place following the receipt of Mr. Stott's letter of 13 January 1986. This suggests either that the check visit was overlooked or that HSE by then accepted that no drench system would be installed.

The next recorded visit was on 7 April 1988, almost two and a half years later. Alex Keddie attended at the site for a planned visit. He noted that the check visit proposed for May 1986 had not taken place; that the letter of 13 January 1986 confirmed that a water drench system had not been fitted; that the bund wall had been damaged and that he planned to visit with someone from the Field Consultancy Group as soon as possible for enforcement action. The other matters were noted as having received attention. As it was his first visit, Mr Keddie checked to see if outstanding matters had been dealt with. His reference to enforcement action was an expression of his view before he obtained advice. He did not carry out his own assessment of

the LPG installation but concluded that the recommended improvements had not been completed. The bund wall had also been damaged.

On 11 April 1988, Mr. Keddie wrote to ICL Technical Plastics Ltd, for the attention of Mr Stott, mentioning that the bund wall was collapsing; that combustible material was stacked around the tank and that the recommended fire extinguishers were not to be seen. Another specialist inspector would be asked to attend at the premises to check whether the earlier advice remained appropriate. The combustible material should be removed from around the tank but it was acceptable for non-combustible material to be there if adequate access was maintained.

On 13 April 1988 Mr Stott replied. He said that the combustible material had been removed from the area of the LPG cylinder and that builders had been instructed to repair the wall. He said that he would appreciate a visit from a specialist inspector to discuss the LPG storage problems and try to resolve them. He asked that the visit should be in May as he would be out of the country from 22 April.

On 25 April 1988 Alex Keddie referred the case to a specialist inspector in FCG and requested a visit. On 26 April 1988 FCG acknowledged Mr Keddie's request. No visit took place until August. Mr Keddie said that he was not surprised by that delay as the indication that he had given was that, while it merited immediate work, he did not consider it to represent a particularly imminent risk. His focus was on the location and spacing of the tank and not on the pipework. He had no recollection of raising the pipework as an issue.

Mr Keddie could give no reason why the water drench system had not been installed, other than to say that while sometimes it is easy to make recommendations, it can be practically difficult to apply them. In some instances that he knew of, there had not been a sufficient water supply.

Mr Keddie moved to Newcastle in June 1988 and handed his files to John Ives, his line manager, then Principal Inspector in charge of the Operational Group for the maritime and chemical industry.

At about the time of Mr Keddie's letter of 11 April 1988 to ICL Technical Plastics Limited, the HSE recommendations were the subject of an exchange of internal memos between Campbell Downie and Frank Stott. On 13 April 1988, Mr Downie wrote to Mr Stott recording that a "bund wall around the tank (with railings)" was part of an early recommendation in siting the tank, but that later inspectors had reversed that decision and railings were removed. One inspector had suggested removal of the bund wall, but this had not been implemented. The exchange also referred to the requirement for a drench system. I shall refer to this exchange in a later chapter.

Neither Mr Downie nor Mr Stott advised Mr Keddie of their position on the drench system, the installation of which had been outstanding since 1982. Mr Keddie confirmed that, so far as he could recollect, no one at ICL had tried to talk him out of the requirement for the drench system.

The events concerning the visit to Grovepark Mills on 9 August 1988

The visit by a specialist inspector requested by Mr Keddie in April took place on 9

August 1988. John Ives attended for that visit with Alan Tyldesley, who had recently been recruited as a Specialist Inspector working with the Field Consultancy Group dealing with fire and explosion. This visit was to "see the unsatisfactory LPG installation." It led to a consideration of the underground pipework. It was neither a general inspection nor a check visit. It was recorded as "miscellaneous."

It was clear to Mr Ives that the siting of the tank did not comply with the separation distances contained in HSE guidance HS (G) 34.

This was a publication that contained HSE's working guidelines for bulk storage. It had replaced the earlier Guidance Note CS5. Mr Ives had received the HS (G) 34 guidance around August 1987 and thought that it was considerably clearer than CS5. Mr Tyldesley confirmed that FIC 286/43, the earlier internal HSE guidance, was not referred to in its bibliography because FIC 286/43 was not a published document and at that time was about to be cancelled.

Mr Ives and Mr Tyldesley met Frank Stott on 9 August 1988. Mr Ives said that he found Mr Stott to be pleasant and amenable. The principal concern of Mr Ives and Mr Tyldesley in the course of the visit was the location of the LPG tank and the storage of materials in the vicinity of it, a problem on which Mr Stott had successfully stalled for so long.

There was a further exchange of memos between Frank Stott and Campbell Downie which are detailed elsewhere in this report. Frank Stott's memo of 18 August concerned the visit by Mr Ives and Mr Tyldesley. He advised Mr Downie that the two-tonne tank in the yard had once more become the focus of attention with the factory inspectors; that they had

expressed extreme concern at the continued use of the tank above the surface and that they seemed highly displeased that ICL Tech had not complied with their request for a water drench.

Following the visit, Mr Ives noted:

“Visit with Mr Tyldesley FCG; Mr Stott, Managing Director seen. Visit to see the unsatisfactory LPG installation. Mr Stott was advised to take immediate action to remove all materials stored within the separation distance. This tank is one of the worst sited I have ever seen and it is difficult to know what to do with it. I propose to await Mr Tyldesley’s report and perhaps discuss the matter further with him before taking action.”

During his visit with Mr Ives, Mr Tyldesley inspected the external LPG installation above ground and the vapour off-take pipe within the basement. Following the visit he prepared a Report for Mr Ives.

Mr Tyldesley’s report dated 22 August 1988 detailed that the tank had been previously inspected by Dr Gunn of FCG in 1982 who had recommended a package of improvements, intended to be implemented as a whole, but which had been followed only to a limited degree leaving “a still unsatisfactory installation”. Mr Tyldesley said that, in short, the safety issues relating to the tank had not been effectively dealt with since Dr Gunn had visited the premises. Mr Tyldesley noted that progress had been made since 1982 in that the brick wall had been extended to create a fire wall separating the tank from the roadway.

Mr Ives explained in evidence that where a company was unable to meet separation distances for an LPG tank, there was the

possibility of building a “radiation wall” between the tank and the boundary. The purpose of the radiation wall was to protect the tank from fires or any other heat source emanating from outside the site. However if there was an absence of ventilation at a low level then if there was a leak, the gas could accumulate around the base of the tank and present a hazard.

Mr Tyldesley explained that the separation distances were inadequate. They were important. A nearby fire could cause a tank to overheat and explode should gas not be released from the pressure relief valve. Small releases of gas above ground could disperse safely if the location was well ventilated. Separation distances could provide some assurance of this, if adequate. A solid wall provided protection from a nearby fire, but would also hinder the dispersal of a leak.

No fixed drench system had been installed and there was no water supply immediately by the installation. Mr Tyldesley told the Inquiry that the recommendation for a drench was unusual for a tank of that size. In his view, tanks of 25 to 50 tonnes might possibly have been recommended by HSE at that time to have a water drench system. He doubted whether a case could have been shown for a drench for the tank then in place at the site. Mr Ives said that he did not think it was normal practice to have a drench system on a small tank and would have expected it to be suggested for a 100-tonne tank rather than a 2-tonne tank. Mr Ives had no recollection of ever having seen Mr Stott’s letter of 13 January 1986 informing HSE that no practical solution to spraying the tank had been found.

Mr Tyldesley recorded that road tankers now stood outside the yard during filling, as recommended by the HSE. This took place at about four-weekly intervals. Mr Tyldesley noted that there was an unsealed drain cover located where this took place. This created a potential risk as gas releases were more likely at the filling of the tank than at any other time. If this occurred near an open drain the gas could enter and accumulate, which could lead to an explosion.

Mr Tyldesley thought that the earthing pin used to draw any static electricity from the tank, supplied in response to Dr Gunn's recommendation, was of doubtful effectiveness. There were no dry powder extinguishers provided at the time of the visit, although it was claimed that these had been obtained.

The clutter close to the tank was considerable. Various metal items and some rubbish were immediately adjacent to it. A steel dismantlable road container some four metres away from the tank contained large quantities of cardboard. Mr Tyldesley said that he recommended that the occupiers should get rid of this. This added to the enclosed state of the tank, with a consequent reduction in ventilation. The clutter was obstructing ventilation and it was flammable. Combustible items situated close to the tank could lead to an explosion.

The tank was only 0.3m from the boundary wall at the adjoining factory roadway and only 0.6m from the wall dividing the factory yard from the waste ground used as car parking. If gas were to leak or to be spilled near the tank, it would be difficult for the LPG to disperse.

Mr Tyldesley's conclusion was that there was insufficient space within the yard for a 2-tonne

tank. It was not possible for it to comply with the separation distances in Guidance Note CS5 or its replacement booklet HS(G)34. If it were to be located below ground, it would not comply with the required separation distances and would give rise to a different set of regulations altogether.

The only way to achieve a satisfactory installation would be to reduce the total inventory and the maximum size of an individual tank. Mr Tyldesley noted that if this option was unacceptable, the occupier would still have the option of trying to convert his LPG-fired equipment to burn natural gas supplied elsewhere in the factory, or attempting to lease some of the waste land nearby for siting an LPG tank.

In summary, Mr Tyldesley's recommendations were:

Recommendation 1: the quantity of LPG should be reduced to a maximum of 750kgs.

Recommendation 2: no individual tank should have a capacity exceeding 250 kgs. The benefit of having three 250 kg tanks, rather than a 2-tonne tank, was that there would be less gas to expand in the event of a BLEVE.

Recommendation 3: the separation wall to the west, between the yard and the open land from the existing gateway to the corner by the adjoining premises, should be removed and replaced with a substantial wire mesh fence or metal paling type fence at least 1.8 metres high. It transpired that this recommendation gave rise to security concerns.

Recommendation 4: no tank should be closer than 2.5 metres from the new fence or the factory building; that at least 1 metre should be left between the tanks and no tank should be closer than 0.3 metres from the wall separating the factory yard from the adjacent roadway.

Recommendation 5: combustible materials and vegetation were not to be allowed to accumulate within 2.5 metres of any tank and the storage of equipment or materials within the yard, which would impede ventilation of the area around the tank, should not be permitted.

Recommendation 6: a 19 mm hose reel capable of delivering at least 30 litres a minute of water should be provided at the LPG installation. Alternatively, two 9 litre water extinguishers could be provided. In either case, the equipment should be protected from freezing in cold weather.

Recommendation 7: two 9 kg dry powder extinguishers or equivalent were to be provided at the installation.

Recommendations 6 and 7 were simple standard fire precautions that were normal for an installation of that size. They were not recommended in place of the drench system. Recommendation 8: during LPG deliveries at least one factory employee should be present who had been trained and had received written instructions in the procedures to be followed during filling, the hazards of LPG and the action to be taken in an emergency. The employee would have a role in telephoning or raising the alarm if anything went wrong.

Recommendation 9: if the tanks were to be manifolded together for vapour off-take, a shut-off valve should be at the manifold so that the supply to the building could be isolated by the closure of a single valve outside working hours or when the burners were to be out of use for an extended period. Mr Tyldesley was looking to minimise the risk of a leak into the building by turning the gas off every time the building shut down and the oven was not in operation. This was an unusual suggestion.

Recommendation 10: a "T" joint in the LPG pipework in the basement of the building noted to be sealed by a single valve was recommended to be sealed with a screwed plug or other appropriate fitting. Mr Tyldesley wished it to be properly sealed to avoid the risk that the valve might be opened accidentally.

Recommendation 11: "Part of the underground pipework carrying LPG vapour into the building should be excavated. The state of the pipework and any corrosion protective coating should be examined by a competent person and any recommendations made as a result of this inspection should be carried out. A pressure test of the pipe work should also be carried out.

Recommendation 12 recommended finding out the nature of services under the manhole cover immediately outside the factory yard gate. The manhole should be protected with a cover sealed against ingress of liquid or the tanker should not stand over it during deliveries and should be as far away from it as reasonably practicable."

Mr Tyldesley went into the basement, having asked where the pipe went from the tank. He could not recall, but believed that he could not tell what the pipe was made of and whether it was corrosion-protected, and that he would have asked ICL Tech about it but got no clear answers. He remained concerned to find out the condition of the underground pipework between the tank and the building and concluded that that this could be ascertained only by excavating it.

When questioned about LPG pipework passing through the basement, Mr Tyldesley said that this was poor practice and that it was one of many things that caused him concern at the site. The degree of risk in all instances depended on where the ventilation for such areas came from.

Mr Tyldesley explained that a “competent person” in the context of Recommendation 11 could be someone with the relevant theoretical and practical experience, including knowledge of the current guidelines; for example the gas suppliers or someone recommended by them.

He recommended a pressure test as it was quick and easy and would indicate whether the pipework was leaking at that time, but it would not determine the condition of the pipe, whether it was protected or whether it was showing signs of corrosion. Such a test would be carried out at a higher than operating pressure so that there was some degree of reassurance that the pipe would not fail quickly after the test.

Mr Tyldesley said that a pressure test was not an alternative to excavation. Excavation gave some idea of the risks in future which pressure testing might not identify.

The summary of Mr Tyldesley’s inspection report dated 22 August 1988 recorded that there was

“a 2-tonne tank located in very cramped conditions close to the site boundary in a small factory yard and was the subject of an earlier FCG report. Some earlier recommendations had been implemented, but current conditions were now worse”

and that

“Support is given for an Improvement Notice requiring LPG storage to be reduced to a maximum of 3 x 250 kgs, together with various associated improvements to ventilation, first aid, fire fighting and other matters.”

Mr Tyldesley noted that co-operation from the occupier without enforcement action seemed unlikely and that his recommendations were intended to form the basis for an Improvement Notice under the Health and Safety at Work Act 1974. Mr Tyldesley explained that his comments on the unlikelihood of co-operation would have been based on the lack of action between 1982 and 1988.

A further question mentioned was that that there was a “matter of evident concern to general fire precautions within the factory.” This question related to the storage of a propane bottle on the stairs from the basement to the floors above the ground. This was a matter properly controlled under the Fire Precautions Act 1971. In Mr Tyldesley’s view, the proper course was to report the matter to the Strathclyde Fire Brigade as the responsible fire authority.

Mr Ives was happy to accept Mr Tyldesley’s recommendations on the basis of Mr Tyldesley’s

judgment. Mr Ives considered that the recommendations were based on Mr Tyldesley's expertise, were consistent with policies, and were entirely reasonable.

Mr Ives confirmed that he had been aware of concerns about underground pipelines and the need for inspection, including pressure testing. In 34 years in the HSE he had attended a number of training courses on LPG but could not recall there ever being any discussion of the issues involving LPG pipelines. In 1988 LPG was not highlighted as an issue for HSE. The focus was on the tanks and not the pipework.

Mr Ives decided to go back to the premises to discuss Mr Tyldesley's report with Mr Stott. Mr Ives went there with William Reilly, another inspector, on 1 September 1988. In Mr Ives' view it was difficult to resolve the problems concerning the tank. Given the history of the clutter around it, he thought that the best solution might be for it to be dispensed with. The entry in the Reports on Visits form recorded that:

"Mr Stott opened the meeting by announcing that he was transferring his oven from LPG to mains gas which will reduce the need for the LPG store. It appears that a small tank will still be needed for the central heating system. Letter and CV proposed to ensure that Mr Stott keeps his word."

The entry "CV" is a reference to a "check visit" marked for November. Mr Ives explained that in his view Mr Stott did not have a good track record of delivering and it was necessary to keep pressure on him although he did appear to accept advice. Mr Ives had subsequently marked the file to cancel the check visit as negotiations

were underway. He could not recall why, when he cancelled it, it was not marked up for a later visit.

Mr Ives went through the recommendations in Mr Tyldesley's report with Mr Stott during the meeting. In relation to the pipework, Mr Stott did not think that excavating the pipe was a practical option as it would mean digging up the yard. Mr Ives did not discuss any alternatives with him. Mr Ives was clear that Mr Stott's view on the proposed excavation had no effect on the HSE's recommendation that part of the pipework should be inspected through excavation. Neither did Mr Stott's suggestion that he might dispense with the LPG installation altogether. Mr Ives' recollection was that Mr Stott had indicated that he was going to discuss the whole issue with Calor and would approach them for a new proposal. Mr Ives thought that Calor had put the pipework in but he could not recall why he thought this. No representation to this effect had been made to him by Mr Stott.

Following this meeting the matter effectively went into abeyance pending Mr Stott's discussing the position with Calor.

On 8 September 1988 HSE wrote to ICL Tech with the recommendations that had been set out in Mr Tyldesley's report.

Mr Stott replied on 1 December 1988. He said that ICL Tech had issued new instructions to employees as to procedures to be followed when the LPG tank was being filled. Mr Stott also wrote to Calor enclosing a copy of the procedure that would be displayed on the ICL premises as a sign. He asked Calor to instruct their personnel accordingly. A copy of this letter with its enclosure was sent to Mr Ives.

Mr Ives said that, on receiving the letter from Mr Stott, he telephoned Mr Coville, whom he knew well. He and Mr Coville had had regular contact where persons with LPG installations sought guidance and where they were trying to resolve difficulties regarding such installations. When incidents occurred they would work together to try to improve practices.

On 6 December 1988, an internal Calor Gas memo was sent from Mr R Love to Mr Alexander Clezy attaching a copy of Mr Ives' letter of 8 September 1988, setting out the questions raised by that letter and attaching a plan of the LPG tank in relation to the yard and the factory. The memo was annotated as being passed to Mr Coville to enable him to deal with the questions arising from it. Mr Coville had no recollection of seeing it but assumed that he must have done so. Parts of the memo are illegible. It refers to there being attached to it a copy of the letter from Mr Ives of HSE to ICL Technical. It refers also to the 2-tonne tank being only 7.3 metres from the building and being too close to the radiation wall. It suggests the problems could be resolved by replacing the 4,000 litre tank with a 2,000 litre tank but that this would not appear to satisfy Mr Ives.

Mr Coville by reference to his log said that he had been to the ICL premises on 19 December and was aware then of the contents of Mr Ives' letter. His log reference indicates that he had carried out a Bulk Report, containing all the information relating to the tank, details of testing and other relevant information gleaned at the visit to the premises. The reference for this report was BR05969. There is a reference to "the plan to HSE for approval".

Mr Coville also visited the premises on 4 January 1989 and wrote to Mr Ives on the same day.

The letter was in the following terms:

"I refer to your letter to the subject Company, dated 8 September 1988, regarding our bulk LPG storage facility located there.

On behalf of ICL Technical Plastics Ltd and following my telephone call to you on 23 December 1988, the attached sketch plan outlines suggested suitable remedial action, to be taken by Calor Gas Limited, in order to meet the recommendations made at paragraphs 1, 2, 3 & 4, only of your above-referenced letter. With regard to paragraph 11 of your letter, the condition of the attendant vapour-off take pipe would be ascertained, during vessel exchange, by examination of the "riser pipe" at the vessel, and by a pressure test on the pipeline.

I trust you will consider the above measures to form an acceptable compromise to your recommendations, and that they meet the spirit of the Guidance Note HS (G) 34 (the storage of LPG at Fixed Installations) whilst maintaining security of the installation, and the premises it is to serve, in an area with a reputedly-high incidence of "unauthorised entry" to property.

It is understood the remainder of your letter will, in due course, receive the addressee's attention for reply but, meantime, your early return to this letter will be greatly appreciated; prompt remedial action will then follow".

Mr Coville explained that the purpose of this letter and accompanying plan was to suggest possible remedial action in respect of the recommendations made by Mr Ives in his letter of 8 September.

Calor were unable to supply tanks as small as 250 kgs. Mr Coville indicated that the installing of a 1-tonne tank to replace the 2-tonne tank at ICL would reduce the capacity held on site. He understood that this would comply with the necessary regulations in the broader circumstances. The plan indicated that the HS(G)34 recommendations as to separation distances could be met with the exception of the narrowest point of distance from the west wall where the wall ran past the tank at an angle. The gap at its narrowest was 0.5m to the corner of the tank. If a radiation wall was solid and of a certain height then it could be that the tank could be closer than that recommended in the table of separation distances in HS(G)34. Mr Coville also said that if ICL Technical Plastics had owned the land outside the western side of the wall and the gate, the requirements of HS(G)34 would have been met. His recollection was that ICL Technical Plastics were intending to acquire that land and subsequently did so. I will return to this point.

Mr Coville also proposed the installation of a vehicular barrier, which he suggested might be of a steel "motorway" type, or strategically placed concrete bollards. This would reduce the likelihood of any contact with the tank in the event of a forklift or other vehicle being used in the yard. It would act essentially as a crash barrier. He marked on the plan the radiation wall suggesting that the existing height of the wall was to remain as it was, stepping up between 1.8 metres to 2.6 metres. He also

noted that no building, combustible materials, non-flame proof electrics or car parking should be within a line to be painted round the tank 3 metres from it. His plan showed that that line should be "suitably extended to beyond the ventilated gate-wall." He highlighted that this area should be clearly defined, for example by floor-painted lines. He also indicated that the gate wall should be vented at floor level by the staggered removal of some bricks along the full length of the wall. This would prevent there being a solid return on the radiation wall that could allow LPG to accumulate in that area if there should be a leak.

Mr Coville knew that his proposals did not wholly meet the requirements of HS (G) 34, but they were an attempt to reach a compromise on vessel size. In his letter he was clear that the "suggested suitable remedial action, to be taken by Calor Gas Limited", was "in order to meet the recommendations made at paragraphs 1, 2, 3, and 4 only of your above-referenced letter."

Mr Coville said that he would have consulted the technical department in Calor in relation to paragraph 11 in accordance with Calor's policy and that he would not have made the suggestion about recommendation 11 "off his own bat." He would have spoken to the Regional Technical Manager, Mr Clezy, because the recommendation involved pipework. Mr Coville explained that the vapour off-take pipe is the whole length of the pipework from the tank to the appliance or equipment using it. The riser pipe was the visible part of the vapour off-take pipe from the tank to the ground level. The proposal for pressure testing the pipeline is said to have accorded with prescribed practice current at

the time. Mr Coville had no recollection of the reasoning for this response nor could he recall any details of any discussions with the Regional Technical Manager.

Mr Clezy died before the conclusion of the criminal proceedings. After the disaster, he gave two statements to the authorities. These were available to the Inquiry. Mr Clezy was a member of the Institute of Gas Engineers. Mr Clezy is recorded as having recalled that the position of the tank posed problems on access to the tanks and in relation to separation distances. He had recommended that a 2-tonne tank be replaced with a 1-tonne tank. He was not involved in any pipework from the regulator as Calor's responsibilities ended at the regulator. He said that he agreed with Mr Coville's letter of 4 January 1989. He said "The word compromise means we are offering an equivalent alternative standard of safety." Mr Clezy said that when he took over as technical manager in the mid 1970s he required that all joints in underground LPG vapour pipework should be wrapped with Denso tape. He had not heard of any explosion from an underground vapour pipeline. He noted that there was a different standard for liquid pipework.

Mr Ives considered the letter and plan received from Calor and the remedial suggestions. Mr Ives said that whereas Mr Tyldesley had recommended a wire mesh fence, he understood from the Calor's letter that ICL needed walls to keep out vandals.

The fact that the Calor letter of 4 January was written on behalf of ICL Technical Plastics Limited was acceptable to Mr Ives because Calor owned the tank. If the installation was

not to Calor's standards, they could refuse to supply the customer. Mr Ives took the view that ICL Plastics had authorised Mr Coville to make these proposals. Mr Ives commented that they wrote most of the guidance and were the major player in the industry. HSE's own top LPG specialist had been recruited by them to be their group safety manager to manage their regional safety inspectors and to help to formulate Calor's safety policy. HSE's requirements had to be both practical and robust to avoid criticism if, for example, the matter proceeded to enforcement action. Mr Ives explained that the problem that he saw in this context lay with the counter proposals from Calor and with Mr Tyldesley's advice in relation to the tank sizes. Calor could not supply a 250kgs tank, as HSE recommended. The recommendation to excavate the underground pipework was not an issue in this context. Mr Ives considered HSE to have been on certain ground in respect of that recommendation. The Calor letter of 4 January appeared to form a reasonable solution to a difficult problem from a siting point of view. A smaller tank was being suggested, there were proposals to improve ventilation and they had tried to take action to avoid clutter. Mr Ives considered the proposal, though not perfect, was a major step forward.

Mr Coville had suggested a test of the underground pipework by inspection of the riser pipe at the vessel together with a pressure test when the tank was replaced, rather than by excavation. Mr Ives did not feel competent to decide if that was a reasonable compromise. He passed the proposals to Mr Tyldesley for his comments. Mr Ives confirmed that he was aware that pressure testing of a vapour off-take pipe would have revealed whether the pipework was leaking at the time of the test, but not whether

it was corroded. He could not recall at twenty years distance whether he had been aware of the HSE circular FIC 286/43 Rev.

Having seen Calor's counter-proposal, Mr Tyldesley sent a memorandum to Mr Ives dated 17 January 1989. At paragraph 3 he said:

"If the occupier can somehow gain control of extra land outside his existing premises, so that he has full control over all land within 3 metres of the proposed tank, then these proposals are acceptable. If this condition cannot be met, then I stand by my earlier recommendation and would be prepared to support enforcement action in respect of them. In respect of Recommendation 11 regarding examination of the underground pipework from the installation, then the proposals by Mr Coville are acceptable."

At paragraph 4 he said:

"This is a particularly poor LPG installation which has been in existence for an excessive time. I hope that appropriate enforcement action will now be taken to ensure that the installation is improved without delay".

Mr Tyldesley confirmed he was prepared to support enforcement action if the occupier should fail to gain control of the extra land outside the premises and thereby gain full control of all land within the 3 metre separation distance. There was concern that since ICL Tech did not control the land beyond the wall, it meant that activities could take place beyond the wall which could create a risk to the tank.

Mr Tyldesley did not explain in his memo why the counter proposals to recommendation 11 were acceptable. He said that he believed that he would have taken Mr Coville's proposal to mean that he was going to dig down a short way to ascertain the condition of the pipework and would have taken the reference to the riser pipe to have been a reference to the vertical section of the pipework, including that which was underground. This was because examining the pipework above ground would tell no one anything that could not already be seen. In his memo to Mr Ives, Mr Tyldesley referred to "regarding examination of the underground pipework from the installation." This indicated that he had not interpreted Calor's proposal to relate solely to the visible pipework. He speculated, with hindsight, that he must have thought that there were four possibilities: that Mr Coville did not appreciate the risks and consequences of an underground leakage, but had nevertheless given advice; that Calor did not wish to take responsibility for a pipe that they knew was not theirs; that they did understand the risks but thought it reasonable to look at the above ground section; or that they did intend to excavate the pipe, but that the instruction was not carried out when the tanks were changed two years later. It would be convenient to examine pipework when the gas would be turned off as Mr Tyldesley considered that there would be a fair chance of putting a spade through a pipe if it was very corroded.

Mr Tyldesley's view was that Mr Coville, acting on Calor's behalf, was taking on the responsibility of a "competent person". He had felt entitled to assume that Mr Coville and other technical employees of Calor would have recognised the significance of the underground pipework and taken steps to follow his

recommendations. He took for granted that Mr Coville's proposal would involve some form of investigation below the surface of the ground since without this it was impossible to determine the composition and state of the pipe or what corrosion protection it had. Mr Tyldesley now considered that the letter from Mr Coville was ambiguous, but at the time he thought that Calor were competent. He had assumed that Calor would understand the problem, its possible consequences, and how it could be resolved. He had not clarified the position. Mr Coville has said that he was responding on behalf of Calor in relation to the areas of the installation that were owned by Calor.

Mr Tyldesley considered that a competent person would advise a factory owner what needed to be done in respect of the safety of the pipeline. Mr Tyldesley considered that the problem with Mr Coville's letter was that it made suggestions as to what was to be done without making it clear who was to do it. He had not clarified the position. He said that he had perhaps trusted that Calor had understood the hazard and that they would do what was necessary to ensure that ICL were given sound advice. Mr Tyldesley was clear that his recommendations had been a package and that it had not been a case where there could be picking and choosing.

Mr Ives responded to Mr Tyldesley's report by a memo dated 20 January 1989. He said:

"I would remind you that enforcement policy in this matter rests with myself and I will take appropriate action as I see fit to deal with this matter.

The problem that has arisen is that Calor Gas are telling the occupier and myself

that they do not produce tanks for bulk LPG which meet the standards of your original report. In other words if I were to enforce the letter of your report then this site would have to cease using LPG. In those circumstances I deem it better that we try and reach a reasonable compromise and solution than rush into enforcement action which will backfire. In view of Calor's claims perhaps you could confirm that it is possible for them to supply tanks of volume no greater than 250 kgs".

In terms of HSE protocol, it was Mr Tyldesley's responsibility to report to Mr Ives and make any recommendations. While Mr Tyldesley held a warrant that enabled him to take formal action by issuing an Improvement Notice or instigating a prosecution, it was not his responsibility to do so. That responsibility lay with Mr Ives. It was for Mr Ives to take such action as he thought necessary. It was open to Mr Ives to disagree with an FCG inspector. On rare occasions he had done so. If it was a technical matter, Mr Ives would accept a specialist inspector's advice since a specialist inspector was an expert on process safety. He had done so in this case. Mr Ives did not give any further consideration to the proposal in respect of recommendation 11, nor Mr Tyldesley's acceptance of it. HSE protocol meant that all actions and correspondence were directed through a general inspector. It was therefore commonplace that specialist inspectors did not know whether their recommendations had been applied or not. In Mr Tyldesley's view it would not have been practicable for him to have chased up every specialist recommendation that he issued.

Mr Ives confirmed he was aware of the LPG ITA code of practice, but had not consulted it

in relation to the ICL premises. Where matters went beyond basic issues of siting and storage he brought in a specialist. Mr Ives did not recall FIC 286/43 and FIC 286/43 Revised.

Mr Ives was shown by the Procurator Fiscal a report dated 13 January 1988 on an LPG explosion in an underground firing range in Daventry in December 1987. Mr Ives had had no prior knowledge of this incident. He thought that there had been a system of circulating information of this nature among specialist inspectors, but not among general inspectors. If he had been aware of such a serious incident occurring as a result of unsatisfactory or corroded pipework he might have looked at things differently at Grovepark Mills. Such reports should have been circulated as a high priority to make people aware of the hazards attaching to LPG pipework.

Mr Tyldesley explained that the report on Daventry would have been entered in a computer database called "marcode" but he was unable to give further information about the system as that database was not used by the specialists. Mr Tyldesley was sure that he had not been aware of this report at the time of his visit to ICL premises. From the circulation details on the report, it seemed that it had not been sent to the Fire and Explosion Specialist Group in the Bootle headquarters. In consequence there was no obvious route by which it could have reached the fire and explosion specialists in HSE. Where headquarters staff at Bootle received reports they would raise common patterns but they generally circulated only new and interesting reports. Mr Tyldesley confirmed that he was aware, without having knowledge of this particular incident, that an escape of LPG into a basement could cause an explosion. He

noted that the report appeared to have been sent to the Public Utilities Group, which was a group of factory inspectors who would liaise and co-ordinate HSE's response for the major public utilities.

After the exchange with Mr Tyldesley, Mr Ives wrote to Mr Coville on 23 January 1989. This letter noted that the plan showed that one end of the replacement tank would be only 0.5 metres from an existing brick wall and that this wall was to be ventilated; that the other side of the wall consisted of open ground not under the control of the factory occupier; that it was used for car parking and other purposes and that while the appropriate 3-metres separation distance for the size of tank was marked within the yard it was somehow suggested that this should be extended beyond the ventilated wall. Mr Ives said that the proposal in respect of the tank "is only acceptable provided the occupier can somehow gain control of extra land outside his existing premises so that he has full control of all land within 3m of the proposed tank. If this can not be achieved then I regret that these proposals are not acceptable and we return to the requirements of my letter of 8 September".

Frank Stott responded directly to Mr Ives by letter dated 25 January 1989. He said:

"I can now confirm that we are in fact in control of the land outwith our main factory gate and that we have already moved the car parking facility to the far side of the gate, which would be in excess of 20 metres from the proposed site of the tank.

There is no reason why we should not remove bricks from the wall and we will in fact put up a "No Parking" sign to prevent

other people form using this area as a parking spot. If this proves ineffective we will find some other form of preventative in this matter.

I trust that the above information will allow you to accept the Calor proposals, which we will implement with Calor as soon as possible."

Mr Tyldesley sent a memorandum to Mr Ives on 2 February 1989 which referred to Mr Ives' note of 20 January. Mr Tyldesley recorded that he understood Mr Ives to have subsequently heard that ICL Technical Plastics Limited now proposed to purchase or obtain control of a small area of land close to the LPG tank and that this should allow a greatly improved arrangement around the tank. Mr Tyldesley repeated his recommendation 6.3 of August 1988 that the tall brick wall adjacent to the gates giving access to the factory yard should be removed and that a robust non-combustible open mesh fence or similar security arrangement should be installed at the appropriate separation distance for whatever size of tank was required. He noted with surprise that Calor were unable to supply a tank of capacity of less than one tonne. Telephone enquiries to other gas suppliers indicated that tanks of capacity of 200 kg or 600 kg were available elsewhere.

Mr Stott's letter of 25 January 1989 was plainly untruthful and designed to mislead. Mr Downie confirmed that neither ICL Tech, nor any of the other ICL companies were, either at the date of Frank Stott's letter or at any time before or since then, the heritable proprietor of the area of land immediately outwith the boundary wall to the west of the yard, which was owned by

the predecessors of Glasgow City Council. At about that time the land was used for parking by ICL. Mr Stott must have been well aware that no ICL company had any legal control over it.

Mr Coville visited the premises again on 7 December 1989 and drew up a further plan dated 19 December 1989.

This was a revised version of the earlier plan dated 28 December 1988. Mr Coville thought that this must have been in consequence of his being told that ICL Plastics had gained control of the land outwith the gate. The plan showed two 2,000 litre tanks. Mr Coville proposed the following:

- The wall on the west side to be ventilated at floor level
- The property boundary (radiation) wall which appears to have existed at a height between 1.8 metres and 2.6 metres to remain in place
- Vehicular impact protective barriers of metal motorway type or strategically placed concrete bollards to be put in place
- A separation distance line to be clearly defined by, for example, painted lines on the floor (ground) a distance of 3 metres from the vessels, coming out from the south wall then heading west along towards the boundary wall where the sliding gate is and continuing beyond the sliding gate into the area over which the company had gained control. The distance between the radiation wall and the vessels to be 1.5 metres
- The separation distance between the two proposed tanks to be 1 metre.

From HSE records, it appears that on 17 January 1990, Mr Coville either visited Mr Ives,

or visited the premises and then spoke to Mr Ives. On the relevant Reports on Visits form, Mr Ives recorded in his own handwriting, which is not entirely clear:

"Visit by M Coville, Calor Gas Safety Adviser to say work not yet [correct reqs] but provided new drawing of a proposal – seems satisfactory."

Later events

On 17 June 1991 Calor replaced the 2-tonne (4,000 litre) tank with two 1-tonne tanks. The installation of the two tanks was consistent with the final drawing prepared by Mr Coville and approved by Mr Ives. There is no evidence as to whether Calor ever inspected the riser pipe.

Mr Ives marked the file for a check visit in "3/90". Mr Ives said that this should have been entered into the computer system known as SHIELD which HSE used at the time. This should have resulted in the file being passed by administrative staff to the Inspector who had marked it for a check visit; that is to say, Mr Ives. The check visit was not carried out in March 1990. Mr Ives suggested it was possible that the follow-up visit was not entered into the SHIELD system and with the pressure of other things it may have been forgotten in consequence of administrative error.

By the time of the explosion the proposal to remove bricks from the lower part of the wall to the west of the tank so as to provide ventilation had not been carried out.

The next visit is noted in the Report on Visit Form as being on 9 January 1992. Mr Alistair McNab, an HSE Inspector, visited Grovepark Mills on 9 January 1992 and met Mr Stott. Mr McNab carried out a diagnostic inspection.

He described this as sampling activities with a view to diagnosing any problems with the management of health and safety. The purpose was not to check every single hazard or risk or activity in the factory, for it was impractical for him to do so and that was in any event the responsibility of the duty holder. He assessed the LPG installation in line with the HSE's priorities at that time. He concentrated on the separation of tanks and buildings, ignition sources, tanker filling, fire precautions, water supply and staff training and awareness in the risks and precautions affecting LPG. He concentrated on the management and the director roles. He noted that Mr Stott had admitted that health and safety was not a regular feature on the agenda and had promised to rectify this. He also noted that Mr Stott was a managing director "who does 'inspect' the factory. I feel that [improvement notices] are unnecessary on COSHH and NAW as the company is nearly there and a letter should suffice."

Mr McNab was concerned that the company should be ready to audit itself for risk. His visit was in part to prepare ICL for its obligations to appoint one or more 'competent persons' to assist in identifying risks within the workplace and to develop measures to minimise these. These obligations became mandatory for employers on 1 January 1993 under the Management of Health and Safety at Work Regulations (MHSR) 1992, later modified by the 1999 Regulations.

Mr McNab considered that there was a range of hazards wider than was normal for a site of ICL's size. He concentrated on pushing the director to manage health and safety better rather than to rely on the annual inspections,

as ICL appeared to be doing. He considered that this reliance was not unusual and that self regulation was rarely encountered.

This visit was the overdue check visit following Mr Tyldesley's recommendations and the acceptance by HSE of Mr Coville's response to them. There is no record of a follow up by Mr McNab on the examination of the riser proposed by Mr Coville and the underground pipework does not appear to have received any attention. Mr McNab's record of visit contains a handwritten addition "LPG seems to meet 1990 agreement". He confirmed that the manuscript addition was in his handwriting and that it would have been done at the time to avoid his having to put the whole file back to the typing pool for a minor amendment. Mr McNab could not recall why he had used this phrase as shorthand on the file. In fact, the agreement with Calor had not been fully implemented.

Mr McNab believes that he made the handwritten entry between the visit on 9 January 1992 and his follow up letter to ICL Tech dated 23 January 1992.

On 23 January 1992, Mr McNab wrote to Frank Stott on the matters covered during his visit and enclosed an appendix listing the legislation and guidance likely to apply to the business. He made it clear that his inspection was not intended to cover every health and safety issue in the factory. The guidance included procedural and other recommendations, including a recommendation to consider and discuss hazards and risks in the business and to develop safeguards and procedures to eliminate or minimise the identified risks. In respect of COSHH, Mr

McNab advised that consideration be given to the issues of adequate assessment of the risks from hazardous substances and the protection required for employees. Data sheets with analyses of tasks were identified by Mr McNab as the starting point of an adequate assessment. He also suggested that they might wish to engage an occupational hygiene consultant to assist them. He thought that it was also necessary to provide sufficient information and training for employees about risks and precautions.

Mr Stott replied on 24 February 1992. He said that they had obtained the publication *Successful Health & Safety Management* which was being passed to all managers and foremen to read. They were to sign to indicate that they had done so. Various actions had been taken in respect of COSHH and the Noise at Work Regulations. Since Mr McNab's visit they had become aware of their precise obligations regarding the reporting of incidents. This was now being complied with and was public knowledge within the company. A copy of the HSE letter and its appendix had been placed on a notice board by the time clock and they were attempting to create an "awareness" among employees. He said that health and safety was now on the agenda of their monthly management meetings and certain specific points in the letter of 23 January were being considered.

Mr McNab thought that this was a positive response and that a check visit was not required.

On 18 February 1993, Inspector Brian Cousland attended at the factory. He had a meeting with Mr Stott, Mr Brown, Mr Masterton and Mr Ferguson. After his visit he noted:

"Progress appeared to have been made on COSHH and noise assessments. Monitoring of exposure to substances is carried out routinely and noise enclosures have been constructed for certain operations. The management appeared to be unclear on what action had been taken with regard to the LPG tanks. A number of other matters were noted including guarding of circular saws (see letter for details). I propose a return visit to check on guarding of circular saws and to clarify the situation regarding LPG."

Mr Cousland returned to Grovepark Mills on 5 March 1993 and carried out an inspection. He rated the risk, on a worst case scenario, to be small in relation to employees and non-existent in relation to the public. Mr Cousland followed up his visit with a letter to Mr Stott dated 10 March 1993. He referred to the need to comply with COSHH regulations but made no mention of the LPG installation. Mr Cousland would not have picked up the problems with the pipework even if he had gone back to the factory as it was the siting of the tanks that was the HSE's main focus of concern.

After 1993, there was no further mention of the LPG installation at the site in the HSE files.

Chapter 13 – ICL and risk assessments

Risk assessments

Formal risk assessment in the workplace became mandatory for employers on 1 January 1993. This was imposed by the Management of Health and Safety at Work Regulations (MHSWR) 1992, as modified by the 1999 Regulations. Those regulations provided that every employer was under an obligation to appoint one or more ‘competent persons’ to assist in identifying risks within the workplace and to develop measures to minimise these. A ‘competent person’ is described as someone who has ‘sufficient training, experience or knowledge or other qualities to enable him to properly assist’ in undertaking risk assessment and risk elimination duties.

When these requirements came into force, the ICL Plastics personnel department prepared a risk assessment on the models available from HSE and related it specifically to the processes in which the ICL group was involved. It also adopted HSE’s best practice for health and safety policy in drafting policies that were passed to subsidiary directors and managers.

The personnel department’s role did not cover the management or approval of risk assessments specific to individual subsidiaries.

ICL Plastics’ own staff shared the second floor with Stockline and ICL Tech. It appears that ICL Plastics’ and ICL Tech’s employees were covered under the risk assessment carried out for the entire floor by Stockline.

ICL Tech and Risk Assessments

On 17 October 1996, a health and safety meeting was held in ICL Tech at which Frank Stott, William Masterton (a manager), and Andrew Stott, son of Frank Stott, were present.

The purpose of the meeting was to establish the terms of reference for a risk assessment programme. The minutes record *inter alia*:

“Secondly, it was concluded that our first priority must be to develop an exhaustive list of any hazards that exist at ICL Tech. This it is hoped, shall be compiled [sic] by the 31 October 1996

Finally, it was proposed that the development of plant maintenance hazard booklets should be continued. These booklets are to come under the heading of Fire, Machinery, Compressed Air, Electricity/Gas and Buildings.”

Andrew Stott was asked to carry out the risk assessment by his father or William Masterton. He thought that it was being carried out as good practice and that it represented a genuine desire to address problems identified and to demonstrate a concern for workers’ welfare. He started with a risk assessment specific to the premises, together with an existing list of potential hazards, as a starting point for building a comprehensive matrix for a risk assessment of all of ICL Tech’s activities. Frank Stott, together with Mr Masterton, supervised Andrew Stott’s work. Andrew Stott was a student at Strathclyde University nearing the end of a four year BA course in industrial relations at the time; but he was working on two mornings each week at ICL Tech. He had recently carried out a training needs assessment, something which had been part of his degree. This had involved a systematic review of every process within the fabrication plant and the coating shop. He listed every process taking place, drew up a list of employees, put ticks against their skills in the categories of activities and then compiled a grid to assess how developed they were.

He had never carried out a risk assessment before; but the approach that he adopted appears to have been both systematic and thorough. He read materials on risk assessment, used the HSE hotline and discussed the task with Peter Ferguson, who had carried out a similar exercise. Moreover, he had had experience of working in all the departments since he was in his teens. He surveyed the entire premises. He noted everything that seemed to him to be a potential hazard. He considered the machinery, storage, trip hazards, lighting, fire hazards and chemical hazards. He discussed his work with all of the experienced managers and employees.

It is clear he was familiar with and understood the environment in which he carried it out.

His work was subject to analysis, discussion and progress reviews at meetings with Mr Frank Stott and Mr Masterton. The matrix prepared scored the risks in terms of low, medium or high and then in terms of severity and likelihood of outcome, being given one of 3 priority categories - 'low priority risk-insignificant'; 'medium priority risk-important action within days', or 'high priority-action immediately'. This was the rating system recommended by the Royal Society for the Prevention of Accidents. A course of risk reduction was agreed. Meetings were to be held within the factory. Thereafter implementation of the agreed recommendations was to begin.

The papers relating to this that were recovered after the explosion were confused and incomplete. Some dated from 2001. Some were not prepared by Andrew Stott. The only entry relating to gas pipework was under a hazard grouping headed "ICL Technical Plastics Limited Health & Safety, electricity, gas". The

first item was 'Gas pipes in coating shop are old'. This was the only LPG pipework referred to in any of the risk assessments recovered.

Andrew Stott said that on a matrix he would have shown this risk as catastrophic, but improbable.

In the result, the buried LPG pipework and the section passing through the basement were not included in any of the risk assessments. Andrew Stott had not thought about it; nor had Mr Frank Stott or Mr Masterton. Mr Frank Stott should have thought about it since he knew that the buried pipework had been an issue with HSE in 1988. Mr Masterton, who was concerned in this and later risk assessments, said:

"The pipework in the basement was not checked. I think the underground pipework was overlooked on the risk assessments. On reflection perhaps this should have been checked because it was potentially hazardous".

No one on the premises appears to have thought of this. The whole question was simply overlooked then and in the later risk assessments.

The existence of the tank should have prompted anyone preparing a risk assessment to consider the pipework conveying the LPG to the appliance; but no one thought of that. For everyone involved, hazards that were out of sight were out of mind.

Andrew Stott's involvement in preparing the draft risk assessment ended in late January 1997. The final form of this assessment was dated 16 July 1997.

It was entitled "ICL Technical Plastics Limited, Health and Safety Programme, Risk Assessment Exercise AS/TM/16/7/97." The papers recovered were incomplete for 1997.

Andrew Stott was an impressive and entirely candid witness. I am satisfied that he approached his risk assessment responsibly and conscientiously. It is unfortunate that he missed the underground pipe; but that should have been picked up by the senior management who supervised his work. His father, for example, had every reason to think about that particular hazard. If it was not picked up when Andrew Stott prepared his draft, it should have been picked up by those who prepared the finalised assessment in 1997 and the assessments thereafter.

Stewart McColl, Peter Ferguson, Ian Mavers, and William Masterton carried out the later risk assessments. The defects in the initial risk assessment exercise were perpetuated by them when they used it for later assessments. All of the risk assessments gave an opportunity for the underground pipework to be identified as a risk. No one, with the exception of Mr Tyldesley, thought about the underground pipework, let alone assessed whether it presented a risk.

The risk assessment carried out in 2001

A risk assessment was completed in October 2001 by William Masterton, Stewart McColl, Ian Mavers and Peter Ferguson. An assessment relating to the building itself was carried out by William Masterton. It included the hazards subject to COSHH. William Masterton had neither received nor requested training on risk assessments. He considered himself to

be adequately skilled in conducting a risk assessment from his experience as a qualified engineer, his knowledge of risk assessments in other companies, his general abilities and his common sense. He also recalled HSE visiting and looking at the risk assessments. They did not question them. He took it that they were acceptable.

William Masterton also carried out the risk assessment for the coating shop for the 2001 report. He identified potential risks in terms of severity and frequency. He estimated the risks from looking at the hazard and its past history rather than from guidance. He would also have reviewed the planned maintenance folders. As part of the risk assessment relating to electricity and gas, Mr Masterton noted "Propane Gas Pipes" as a potential risk. He recorded the "potential harm" resulting from the risk as being "leakage and explosion," the "existing measures" to deal with it as being "regular inspection," and the "new actions" to deal with it as being "good practice and review." The frequency potential was marked as 2 out of a possible 6, indicating it as a "possible" occurrence, whilst the severity potential was marked as 6 out of a possible 6, indicating that the result could be "death (several)".

The propane gas pipes referred to in this risk assessment were the pipes in the immediate areas surrounding the LPG oven, which could be affected by a naked flame. Mr Masterton tested these pipes by using washing up liquid and water and spraying it on the joints to see if there was a leak. Mr Masterton carried out these tests a few times before the tragedy. The tests were carried out on all the pipe work in the vicinity of the oven.

The risk assessment carried out in 2002

On 18 February 2002, Stewart McColl sent a memo to a number of ICL employees, including William Masterton, indicating that ICL Tech's insurers required a risk assessment to be carried out and requesting that this be carried out by the end of February 2002. In response, Mr Masterton prepared a handwritten risk assessment. He noted that "gas appliances and pipework" gave rise to a risk of "gas leaks." He proposed regular checks and servicing of equipment on a regular basis. This assessment did not include any reference to frequency or severity potential. Again the pipework assessed did not include the buried pipework between the tank and the building. Mr Masterton said that this was because the "underground pipes were never in the equation." The scoring in the risk assessments would have been discussed by the risk management team.

During the course of the criminal proceedings against ICL, the solicitors acting for the defence took a witness statement from Mr Masterton. He was shown a letter from Mr Ives of HSE dated 8 September 1988. This, I think, was the letter making a number of recommendations concerning the siting of the tank and recommending that part of the underground pipework should be excavated and examined. Mr Masterton had never seen this before. He expressed anger on seeing it, as he knew nothing about its contents in relation to the underground pipes. He was dismayed that the ICL management had failed to inform him about it. However, he could not say whether, if he had had this information, he would have included it in any of the risk assessments that he had carried out.

As a result of an HSE visit on 11 August 2003, Stewart McColl wrote to Annette Leppla, an HSE inspector, on 15 August 2003, enclosing various documents, including a copy of the 2001 risk assessments in respect of ICL Tech. It included the risk relating to propane gas pipes and noted the frequency potential as a "possible" occurrence and the severity potential as indicating that several deaths could result if it did occur. The assessment did not include any reference to the hazards of the buried LPG gas pipes. In Mr Masterton's opinion this was the most accurate risk assessment and to the best of his knowledge was the last risk assessment done.

The effect of the risk assessments carried out by ICL

The assessments carried out on behalf of ICL Tech related primarily to known occupational risks. The gas inside the factory was identified as a hazard but the possibility of a leak of gas from the exterior underground pipes was not considered.

There is no record of anyone on behalf of any company within the ICL group carrying out any risk assessment in relation to the buried LPG pipe.

It is plain that the fact that the existence of the underground pipe was overlooked by all of those who were involved in the risk assessment exercise produced a major failure in safety practice. I find it difficult to understand why that happened. The underlying lesson is, I think, that the senior management at Grovepark Mills relied on their suppliers and, to a lesser extent, HSE for advice on LPG safety and in consequence had only the most diminished awareness and understanding of the risks that attended their installation and of the extent of their own responsibilities.

Professional risk assessment

Following a visit from HSE on 2 February and receipt of a letter dated 7 February 2000 which enclosed an Improvement Notice requiring a COSHH assessment to be carried out by 30 April to assess the risks to employees from hazardous substances used in relation to coating processes, ICL Tech approached a safety consultant, Alistair McCourt, for assistance.

Mr McCourt attended at Grovepark Mills on 16 or 17 February 2000. After his visit, he informed Mr Marshall that he was going to bring in a firm of occupational hygienists who specialised in COSHH, dust in the atmosphere and noise. Mr McCourt returned with Mr Gerry Mooney from Associated Health Services and agreed to provide ICL Tech with a quotation for services relating to health and safety with Mr Mooney providing a quotation for occupational health services.

The quotation provided by Mr McCourt on 25 February 2000 was for a consultancy package providing a tailor-made Safety Management System, health and safety advice, identification of the name of the consultants to be engaged, scheduled visits every six months, updating of the firm's system, and a reduced day rate for additional work. The quotation was based on a three year consultancy contract at a fixed price of £2,200 plus VAT per annum. Other services would be charged at the day rate of £275 plus VAT plus expenses including risk assessments, site inspections, accident investigations, and auditing. LPG was identified in the context of compressed gases in respect of the use of cylinders for the fork lift trucks and the heating on the manufacturing floor. The bulk tank was not identified. ICL Tech's then

managing director, Peter Marshall decided that Mr McCourt's quotation did not represent value for money since Mr McCourt was tendering for services that were already in place and were not in issue with HSE.

Mr McCourt said that if he had been instructed to carry out a risk assessment encompassing the LPG installation at that time, he would have thought that the supplier of the bulk tank would have been responsible for it and that there would have been a written scheme of examination which would have included the pipework. He would not have included the underground pipework in any risk assessment.

Insurers

It appears that in the years 1994-2004, excluding motor insurance claims, there were five minor claims for employer's liability. The Insurers noted that the group had a low accident rate.

On 6 July 1993, ICL Plastics' then insurers, London & Edinburgh Insurance, sent inspectors to examine the site at Grovepark Mills. The ICL representatives consulted were Margaret Brownlie, described as accounts and office manager, and William Masterton.

As a result of the visit, a report entitled Loss Control Engineer's report, was prepared and sent to Margaret Brownlie by J M Britton, Senior Loss Control Engineer. The focus of the report was the activities of ICL Tech. No mention was made of the underground pipework. The report referred to the relevant legislation making it apparent that the Management of Health and Safety at Work Regulations 1992 applied to the company. Comment was also made on the outside storage areas containing propane

cylinders and static propane (LPG) tanks. A guide to written schemes of examination based on the Pressure Systems and Transportable Gas Containers Regulations 1989 was appended to the report. A covering letter dated 23 July 1993 was sent by John A Johnson, Group Loss Control Manager, along with the report to Margaret Brownlie stating that if she should require any additional information, she should contact the authors of the report. It appears that she did not take this offer any further.

On 28 June 2002, Margaret Brownlie wrote on behalf of ICL Plastics to Marsh Ltd, ICL's insurance brokers, and enclosed risk assessments for ICL companies including ICL Tech. None of the risks identified related to the buried pipework. The assessment identified the risk relating to gas leaks as being a possible occurrence but it differed from the assessment carried out in October 2001 in that it identified the severity potential for gas leaks as being only 2 out of 6, that is to say a potential for minor injuries only. This change in the risk assessment remains unexplained.

Chapter 14 – The approach to LPG safety at Grovepark Mills

The part played by the companies

ICL Plastics had limited involvement in health and safety in relation to the operational management of the individual companies. Subsidiaries had responsibility for their own workforce and health and safety policy. The ICL Plastics' personnel department kept itself informed of changes in employment legislation and disseminated that information through to the subsidiary companies. It also ensured that new employees of the subsidiaries were aware of their own health and safety obligations under their employment contracts.

The subsidiaries referred health and safety matters to the holding company only if there was a major policy question, or if some major expenditure was proposed.

Colin Foard was responsible for Stockline's health and safety. Margaret Brownlie was responsible for health and safety at ICL Plastics' offices.

The responsible officer for health and safety at ICL Tech was its managing director. Frank Stott held that responsibility until his resignation in 1998. Thereafter responsibility lay with Peter Marshall until 2000 and then with Stewart McColl.

There was a health and safety management team consisting of Stewart McColl, Peter Ferguson, Ian Mavers, Nicholas Downie and Bill Masterton. The company had in place a Health and Safety Policy Statement.

Within ICL Tech individual departments had responsibility to develop and enforce practices that were consistent with ICL Tech's overall health and safety regime. Individuals within

each department were responsible for ensuring that staff adhered to health and safety rules and procedures.

When COSHH regulations came in, COSHH registers were introduced and maintained. Data sheets were available for workers to review indicating the nature of the product in use and the recommended precautions.

The part played by employees and directors

Campbell Downie

In his evidence to the Inquiry, Mr Downie said that after the executive directors were appointed to the subsidiary companies, his role was only to provide financial and strategic guidance to the group. He became semi-retired in the mid 1980s and was a non-executive director and chairman at the date of the explosion.

Whatever Campbell Downie's formal position may have been, I think it unlikely that in practice his role was as hands-off as he implied. The financial management of the companies was tightly monitored. The directors of the various ICL companies regularly consulted Mr Downie in relation to any decisions that were financially significant. While Mr Downie did not regard himself as having the ultimate control and responsibility for the operating decisions for ICL Plastics, ICL Tech or any of the other subsidiaries, his control over financial matters was such that he exerted considerable influence, directly or indirectly, and whether consciously or not, over those decisions.

In the period 1982 to 1988, internal exchanges of memos between Campbell Downie and Mr Stott regarding HSE concerns about the LPG

installation indicate how closely Campbell Downie was involved in day to day management at that time. There was even one memo in which Mr Downie's approval was sought for the installation of a row of pegs in a cloakroom.

In the period 1982 to 1998, Mr Stott as managing Director of ICL Tech was responsible for health and safety in the factory. He effectively continued with this responsibility until Mr McColl took over in 2000. It is apparent from the evidence that he pursued a policy of non-co-operation with HSE on safety questions affecting the tank installation. At times he actively misled the inspectorate and responded disingenuously to HSE's concerns about the bulk tank. Mr Frank Stott died before the explosion.

In February 1982 HSE submitted recommendations for improvements to the bulk tank storage site. These included the installation of a drench system. Frank Stott telephoned HSE after their visit on 3 December 1982 and said that all of the recommendations, except for the drench system, had been complied with. He said that the drench system had been delivered and was to be installed during the Christmas shutdown period. On 20 December 1982 he wrote confirming this. That representation cannot have been true. It was an attempt to play for time. HSE then recorded on 29 December 1982 that no further action was required. In the event the drench system was not installed, because the water tank required to service it was thought to be too heavy for the roof of the building. No other water supply was available.

In November 1985, safety questions about the tank arose again. On 18 December 1985, HSE wrote to Mr Stott requesting ICL Plastics to let HSE know whether all the requirements of February

1982 had been met and to set out the action proposed to be taken. A check visit was to be made in May 1986. On 13 January 1986, Mr Stott, as managing director of ICL Tech, but not ICL Plastics, to whom HSE had addressed their letter, replied to HSE. He reported that they would again clear the area but that they had not found a practical solution for spraying the tank. HSE recorded on the file that Mr Stott had written indicating that the items brought to his attention had received or were receiving attention.

The question of a drench system arose again in April 1988. Following a discussion between them, Mr Downie sent a memo to Mr Stott recording that

"a bund wall around the tank (with railings) was part of an early recommendation in siting the tank, but later Inspectors had reversed that decision and the railings were removed. An inspector had suggested removal of the bund wall, but this had never been implemented ... It now appears the H & S E wish to reconstruct the bund wall and it is suggested a drench system is installed. Originally the drench system was not a requirement of the Inspectorate for a tank of our capacity. I resist the notion that a water drench system should be installed, indeed we have no adequate water supply at that end of the building and the cost of any effective system would be enormous.

If you cannot agree such problems with the Inspectorate before we dig up and re-surface the yard gate area we will end up doing the yard job twice.

I trust the matter can be resolved to everybody's satisfaction."

Mr Stott responded on 14 April 1988. He said that

“They only want to repair the existing bund” and “we must try to talk them out of the drench but this will be difficult this time around.”

By then more than two years had passed since Mr Stott had written to HSE to inform them that they had not found a practical solution for spraying the tank.

On 18 August 1988, Frank Stott sent a further memo to Campbell Downie telling him of the HSE visit by Mr Ives and Mr Tyldesley, the details of the visit are recorded in the chapter dealing with HSE’s involvement at Grovepark Mills. He pointed out that the 2-tonne tank was again the focus of attention. He said that the inspectors had seemed highly displeased that ICL Tech had not complied with the request for a water drench system to be installed. Mr Stott said *inter alia*:

“I suspect we have reached the end of the road in side stepping their requests (since 1982) and I have taken the precaution of seeking information on the cost of the two alternatives which we may be faced with 1) The changeover of the batch oven to town gas 2) the cost of burying the appropriate sized propane tank somewhere within our boundaries...”

This memo reflects Mr Stott’s temporising and obstructive attitude towards HSE, however justified ICL Tech may have been in resisting the need for a drench system for the tank.

Mr Downie replied on 23 August. He did not remonstrate with Mr Stott for his attitude towards HSE. He said:

“Thanks for your memorandum of 18 August, I note you have taken the appropriate steps.

I am not unduly concerned with the Factory Inspectors displeasure and believe we have complied with historic requirements, generally adopted by other users who do not seem to suffer our local officials’ concern.

In the event we must take action and I would appreciate first having a comment from Calor, as the proposed expenditure in relocating a tank below ground level might require us to consider other options or discontinue the use of propane.”

Mr Ives and Mr Tyldesley thought that Dr Gunn’s recommendation for a fixed water drench system for a tank of that size was unusual. Mr Tyldesley doubted whether a case could have been made for it. So Mr Downie was probably right to question the need for it.

Nevertheless, Mr Downie’s memoranda showed that he too had an unenthusiastic attitude towards HSE. The documents suggest that Mr Downie was prepared to meet HSE requirements if he could be satisfied that they were necessary and that the benefit justified the cost. Mr Downie was prepared to have the yard dug up if necessary but was reluctant to have this done twice. Mr Downie’s reason for not remonstrating with Mr Frank Stott’s comment regarding sidestepping HSE requests was that the purchase of a drench system was an operational decision for Mr Stott. In my view he acquiesced in Mr Stott’s attitude and in doing so condoned Mr Stott’s tactics.

Mr Downie acknowledged that the risk of the explosion was avoidable and that the explosion should never have occurred. He disclaimed responsibility for it on the basis that he was not involved in day to day operational decisions and that responsibility for health and safety lay with ICL Tech. In taking this line he overlooked his own involvement as director when the pipework was installed.

In the course of his evidence Campbell Downie made the following statement:

'This tragedy has been devastating. It has affected all of us personally. In the immediate aftermath of the explosion, my concern was for all the employees and directors, including my son Nick who was buried for about 5 hours and was also severely injured. I just had to say to myself try not to go to bits and try not to let everyone down. I have tried to support everybody since the tragedy. I have tried to keep the companies going. I have come out of semi-retirement to do this.'

He went on:

"That is a matter of the utmost regret for an event which, in hindsight, would seem avoidable and that if it were possible at some time in the future whatever to have a forgiveness for an event that should never have happened, then that would be my wish."

Frank Stott

In a letter to HSE dated 25 January 1989, Mr Stott responded to Mr Tyldesley's requirements for the siting of the tank. He said:

"I can now confirm that we are in fact in control of the land outwith our main factory gate and that we have already moved the car parking facility to the far side of the gate, which would be in excess of 20 metres from the proposed site of the tank."

"There is no reason why we should not remove bricks from the wall and we will in fact put up a "No Parking" sign to prevent other people from using this area as a parking spot. If this proves ineffective we will find some other form of preventative in this matter."

"I trust that the above information will allow you to accept the Calor proposals, which we will implement with Calor as soon as possible."

The bricks were never removed from the wall at the base of the tank to provide ventilation. Mr Stott's representation that ICL Tech had control over the land outside its gates was untrue. The land outside the gates was open to the public.

The issues surrounding the drench system and the car parking had nothing to do with the explosion; but they display Mr Stott's attitude to safety and his apparent lack of comprehension of the thinking behind the HSE recommendations.

Mr Stott was also recorded by HSE on 1 September 1988 as having represented that he was transferring the LPG oven to mains gas. The HSE inspector concerned treated this with scepticism. This representation was untrue. ICL Tech was considering converting to natural gas if the tank problems could not be resolved, but no decision had been made.

Frank Stott's attitude to HSE was uncandid and obstructive. If he had been receptive to HSE's concerns, he might have considered carefully the thinking behind the recommendation that the pipe should be excavated and inspected.

In the result, ICL Tech, through Mr Stott, effectively obstructed inspectors of the HSE in the discharge of their functions.

Mr Stott made a favourable impression on Mr McNab when he visited the site on 9 January 1992.

That was a diagnostic inspection in which Mr McNab concentrated on safety management and sought to have Mr Stott manage health and safety better rather than rely on the HSE inspections, but it was also a check visit following up Mr Tyldesley's recommendations. I discuss that aspect of the visit elsewhere.

Stewart McColl

Stewart McColl was responsible for undertaking and implementing risk assessments at Grovepark Mills. He was therefore closely involved in health and safety in all three companies. In October 2000, Stewart McColl followed Peter Marshall as managing director of ICL Tech. He perished in the explosion. He took over responsibility for health and safety in ICL Tech from Mr Frank Stott. He had a health and safety management team consisting of himself, Peter Ferguson, Ian Mavers, Nicholas Downie and William Masterton. From the evidence of employees and former employees and from the HSE records of his period of responsibility, I am satisfied that he had a genuine commitment to health and safety and was scrupulous in his attention to safety matters. When he was managing director, health and safety was an

item at weekly management meetings and communications from HSE were posted for all employees to see. Mr McColl was intolerant of health and safety infringements. If an employee arrived without correct equipment, he was sent home. On the day of the explosion Mr McColl had taken an employee to task for a breach of safety.

Apology by the ICL companies

In the course of the closing submissions for the ICL companies, senior counsel tendered the following apology:

"Everyone involved in both ICL companies feels profound sadness and regret. What happened on 11 May 2004 has blighted so many lives. Detailed written submissions on behalf of ICL have been lodged in respect of phase one and I do not attempt to rehearse these again but suffice it to say that both ICL companies accept that in respect of the events leading up to May 2004 they fell short of the standards required by the provisions of the Health and Safety at Work Act. While others may have played their part in the mistakes that led to the underground pipe being essentially ignored, both companies and the individuals responsible for overseeing the health and safety of the employees do not seek to escape responsibility for their own shortcomings. It has been said before and should be said again that both companies apologise and express deep remorse for those who have been affected by the tragedy."

The part played by HSE

HSE's approach

Geoffrey Podger, Chief Executive of HSE, said that it was matter of regret that HSE's own interventions were not more successful. He accepted that HSE supervision of the site had been deficient in several respects.

Mr Podger described HSE as essentially conducting a sampling regime under the HSWA, part of which is the promotion of good practice and part of which is the enforcement of safety in individual cases. HSE could help with advice and with monitoring, but at all times it was the duty holder who was responsible and who had the ability to undertake what needed to be done. Mr Podger confirmed that it was his understanding that, on at least four occasions, HSE had not followed up recommendations for check visits until much later than planned. He accepted that Mr Tyldesley's recommendation to excavate the pipe, if acted upon, would have revealed the unprotected state of the pipe and would have given an opportunity for remedial action. That opportunity had been completely missed.

HSE knew of the risks of corrosion and of leakage of LPG into underground voids from at latest November 1980 when the internal HSE field circular FIC 286/43 was issued. That circular applied to underground pipes carrying liquid under pressure, but it noted that the standards could be applied with advantage to pipes carrying vapour.

The inspection system operated by HSE relied on following inspections, on adequate record-keeping of previous visits and on inspectors' own observations and assessments. It is self-

evident that there were failures in this system at the Grovepark Mills. There was an identifiable failure to follow up on previous inspections. There was an inadequate appreciation by HSE at general inspector level of the risk presented by ageing underground LPG pipework of unknown composition. HSE's advice to its general inspectors was focused on the risks of a BLEVE and on the conditions that might contribute to it.

HSE's visits

HSE inspectors visited the site several times between April 1970 and the late 1980s. The presence of the LPG bulk tank was first noted in 1975. Thereafter the inspectors, with one exception, were preoccupied with the risk that the contents of the tank might ignite. The protection of the tank was seen as an urgent priority.

Dr Gunn, an HSE specialist fire and explosion expert, visited the site on 21 January 1982 to advise on the hazards arising from the siting of the tank. It was not within the technical scope of his visit to consider the underground pipework or the route of the pipe when it entered the building. There was nothing in the visible pipework to cause him to consider such matters. Dr Gunn was aware of the risks associated with buried LPG pipework and with the collection of leaked LPG in voids, trenches, basements and other underground areas. He was familiar with HSE internal circular FIC 286/43. He knew that the LPG tank and the pipework were over ten years old, but since consideration of the buried pipework was beyond the scope of his visit, he made no recommendation concerning it. At the inquiry, Dr Gunn accepted that if he had realised that the pipework went into a void, he would have considered the implications of this.

He said that he had no reason to do so since all that he saw was the pipe going off from the tank and through a wall.

The check visit scheduled for May 1982 to check on Dr Gunn's recommendations did not take place until December 1982. It was obvious then that the recommendations had not been implemented in full.

In 1988, Mr Tyldesley was asked to make a specialist inspection and to report.

Mr Tyldesley knew of HSE internal circular FIC 286/43. He visited the premises with Mr John Ives on 9 August 1988. Their principal concerns were again related to the siting of the tank; but Mr Tyldesley identified the existence of the buried LPG pipework. The critical stages that ensued are as follows.

The Ives-Coville agreement

Stage 1

Mr Tyldesley inspected the external LPG installation above ground and the pipe within the basement. He prepared a report dated 22 August 1988 for Mr Ives. He noted that Dr Gunn's recommended improvements had been implemented only to a limited degree and that it was "a still unsatisfactory installation". He made twelve recommendations. Recommendation 11 was as follows:

"Part of the underground pipework carrying vapour into the building should be excavated. The state of the pipework and any corrosion protective coating should be examined by a competent person, and any recommendations made as a result of this inspection should be carried out. A pressure test of the pipework should also be carried out."

Mr Tyldesley deserves great credit for being the only person in this history who was alert to the risk arising from the unknown condition of the buried pipework. His recommendation 11 was critical. Had it been carried out, it would have shown that the pipe was unprotected. In all likelihood the pipe would have shown signs of corrosion, having been buried in aggressive soils for almost twenty years. Mr Tyldesley was perceptive in seeing that the underground pipework was as much a source of hazard as the siting of the tank.

Mr Tyldesley knew that the entry of LPG pipework into an unventilated void was a matter of concern but he did not comment on that feature of the installation at the site. He did not recommend removal or re-routing of the pipework in the basement. I infer that he thought that, though not ideal, the layout did not breach HS(G)34.

In the events that followed the opportunity was missed to ascertain the condition of the pipework and to take action to avoid the risk that it created.

Stage 2

After a further visit to the ICL premises, Mr Ives sent a letter to ICL Tech that set out all of Mr Tyldesley's recommendations *verbatim*.

Stage 3

Mr Stott copied Mr Ives' letter to Calor. On 4 January 1989 Maurice Coville of Calor wrote to Mr Ives on behalf of ICL Tech. In relation to recommendation 11 he made the following counter-proposal:

"With regard to paragraph 11 of your letter, the condition of the attendant vapour

off-take pipe would be ascertained, during vessel-exchange, by examination of the "riser-pipe" at the vessel and by a pressure-test on the pipeline".

Mr Ives passed Mr Colville's reply to Mr Tyldesley for his views. Mr Tyldesley said that the counter-proposal to recommendation 11 was "acceptable". But in relation to the siting of the tank, he said that unless ICL Tech could gain control of the land outside the premises, he would support enforcement action and that he hoped that this would now take place. This comment earned him the heavy-handed response from Mr Ives that I have quoted previously.

Mr Tyldesley said that his understanding of Calor's response was that they were going to dig down a short way to ascertain the condition of the pipework. He said that examining the pipework above ground would tell no one anything that could not already be seen. Calor have suggested to me that there is no evidence that a limited excavation around the riser pipe was not actually carried out and that at that time the pipe may not have been corroded. Had a limited excavation been carried out, on the evidence available to the Inquiry, this would have shown that there was no protection applied to the pipe below ground level. In my view, the fact that industry practice, based on published guidance, was to pressure test to check the integrity of the underground pipework is no answer to the underlying risk that Mr Tyldesley had identified. In my view, Mr Tyldesley should not have accepted the counter-proposal without having it spelled out that Calor's "examination" would involve excavation. Mr Tyldesley's acceptance of the counter-proposal with nothing further said was

the critical event in terms of HSE's involvement. It brought to an end the possibility of HSE's insisting on there being a proper examination of the buried pipework. HSE consider that there were opportunities for ICL, Calor and Johnston Oils to have intervened in the following fifteen years. Mr Tyldesley has said that he regarded the contents of Calor's letter to be an explanation of what they would do rather than a counter-proposal, and that it was implicit in the proposal to examine the riser that this would involve a degree of excavation. In his view, this being the case, acceptance of the Calor proposal should have led to a proper examination of the buried pipework.

At the end of his evidence, and of his own accord, Mr Tyldesley made the following sincere and moving expression of his regrets:

"Last September after the prosecution was complete but before this Inquiry was announced, I put on my website some comments about ICL. These include an apology. I was, and still am, sorry that this disaster wasn't averted. Towards the end of the year Brechin Tindall Oates, who acted at the time for HSE staff, told me to remove this web page. Somewhat reluctantly I did.

During May, when my statement to this Inquiry was being prepared with the help of Pinsent Masons, I wanted again to find a way of saying sorry. We explored various forms of words but could not find any that did not either imply, however obliquely, that anyone else might have anything to say sorry for or appear to take on my own shoulders responsibility for matters over which I did not feel 100% responsible. So the paragraphs were left

out. It seems that once the legal processes start, the word "sorry" becomes very difficult to say. Despite that, I just want the families to know where my sympathies lie."

Stage 4

Mr Ives replied to Calor repeating Mr Tyldesley's view on the counter-proposal to recommendation 11. He did not question Mr Tyldesley's acceptance of the counter-proposal. He relied on Mr Tyldesley as the expert and had no reason to challenge his advice. As a general inspector, he may not have been conscious of the reasoning on which recommendation 11 was based.

At the date of the Inquiry, Mr Ives had no recollection of any specific HSE guidance relating to such dangers, but was aware of concerns about underground pipelines. He said he had relied on the specialist advice of Mr Tyldesley. It is unfortunate that, despite his officious insistence that any decision on enforcement action was his to take, he failed to question why Mr Tyldesley no longer stood by his recommendation 11.

Stage 5

On 17 January 1990, Mr Coville advised Mr Ives that the work on the recommendations had not yet been carried out and that it was now proposed that the single 2-tonne LPG tank should be replaced with two smaller 1-tonne tanks. This was agreed to by Mr Ives as fulfilling Mr Tyldesley's recommendations. Mr Ives noted that a check visit should be carried out in March 1990. This visit did not take place. The two tanks were not installed until June 1991. During that period no initiatives were taken by Calor, ICL or HSE to assess the condition of the underground pipework. It is likely that when the

2-tank arrangement was eventually installed, a pressure test was carried out; but there is no evidence that Calor inspected the riser pipe.

It is now obvious that there was no proper follow-up on the requirements of the Ives-Coville agreement. If the condition of the underground pipework had been properly ascertained in 1989, it is likely that the lack of corrosion protection and the existence and the extent of corrosion would have been identified.

In January 1992, Mr McNab made the long overdue check visit to follow up the Ives-Coville agreement. The only relevant record of this visit is Mr McNab's handwritten note that "LPG seems to meet 1990 agreement". Mr McNab was clearly mistaken. Although the tanks had been exchanged, the agreement had not been fully implemented. Mr McNab was unable to explain how he missed the non removal of the bricks in the wall to increase the ventilation. There is nothing on the file to indicate that he asked whether the riser pipe had been examined on the exchange of tanks and, if so, what was found. This was a further opportunity for the integrity of the underground pipe to be considered. It was missed.

Follow-up visits

On several occasions follow-up visits that were noted to take place on HSE Reports on Visits forms were not carried out. The repeated failures of inspectors to take notice of the buried LPG pipework on such visits or to insist upon a sufficient investigation represented missed opportunities for its continuing corrosion to be detected. Ultimately it fractured.

Conclusion

Looking over this part of the history, I conclude that while HSE's inspection regime is a risk-based sampling regime aimed at promoting good practice and dealing with failures and safety concerns, if need be by enforcement action against the relevant duty holders, the actions of HSE's general inspectors overall were characterised by an inadequate appreciation of the risks associated with buried LPG pipework and unventilated voids; and by a failure properly to carry out check visits.

Can it ever be justifiable for HSE to resile from its own requirements?

HSE represents the public interest. It must assess its requirements by reference to safety criteria and to the tests of reasonableness and proportionality. Its requirements must be uninfluenced by any commercial considerations that may affect the judgment of the owners of the site.

If in response to a prohibition notice or a notice to do work, HSE receives a counter-proposal on behalf of the site owner that could be as effective as that which HSE proposes, it is the duty of HSE to consider that response on its merits. If it is persuaded that the counter-proposal is sound and effective, it may justifiably modify its own position accordingly. That is a realistic and responsible approach to decision-making by a public regulatory body in such circumstances.

But what it must not do is to resile from its own considered position for fear that the site owner may contest the notice and perhaps do so successfully. If HSE remains conscientiously convinced that its proposed solution is the right one, it is its duty to defend that position, even if that means litigation. Mr Podger has confirmed this to be HSE's position.

It is clear from Mr Ives' evidence about the Calor counter-proposal that his decision to accept it was influenced, in part at least, by his fear of the consequences if he should reject it. It was well-known to the Inspectorate that Calor had a history of challenging HSE enforcement notices. In my opinion, Mr Ives' reasoning for accepting the counter proposal ought not to have been influenced to any extent at all by such a consideration.

Calor consider themselves to have a constructive relationship with HSE and reject any suggestion that they intimidate HSE when they occasionally seek to assist their customers to resolve any potential enforcement notice issue. I myself make no such suggestion.

Replacement of FIC 286/43 with HS(G)34

FIC 286/43, was a document internal to HSE for use by general inspectors but also available to specialist inspectors. It applied to liquid carrying pipes but noted the standards could be applied with advantage to vapour carrying pipes. In the period 1984 to 1988 HSE's guidance on LPG was revised. In July 1987, HS(G)34 came into force. It replaced Guidance Note CS5 and HS(G)15 and revoked FIC 286/43(REV). HS (G)34 was a booklet on the bulk storage of LPG at fixed installations. It was on sale to the public. Its target audience was users, suppliers and field inspectors. It was drafted by Dr Fullam.

HS(G)34 was less specific than the approach that had been taken in FIC 286/43 and FIC 286/43 (REV). As in FIC 286/43, the section relevant to underground pipework in HS(G)34 did not apply to vapour pipes. Unlike FIC 286/43 and FIC 286/43(REV), HS(G)34 did not suggest that the standards might with advantage be applied to underground vapour pipelines.

Paragraph 188 of HS(G)34 stated that:

“Underground piping carrying liquid which is laid in a backfilled trench should be examined for corrosion, or tested in such a way as to establish continuing integrity, at least once every ten years.”

In providing that integrity should be tested at least once in every ten years, it was more specific than FIC 286/43 (REV); but it was less specific in its failure to specify what form of testing might be used to establish continuing integrity, in the absence of an examination for corrosion.

Dr Fullam agreed that that HS(G)34 was the “vaguest of them all” in comparison with FIC 286/43 and FIC 286/43 (REV). He said:

“...it reflects the general move towards a risk-based approach not just in terms of LPG but in fact all engineering standards were moving towards a risk-based approach where you didn't give such specific detail but you allowed a competent person to use their judgement based on their engineering knowledge. That was the general trend really in the engineering profession.”

He also said that at the time when he wrote HS(G)34:

“I had an agreement with UKLPG's predecessor that Code of Practice 22 would contain more detail about vapour pipelines and so I put in the absolute minimum basic requirement that you had to protect the thing from corrosion.”

Code of Practice 22 in the event did not come into force until 1990. In Dr Fullam's view it was

directed more towards construction and material than inspection and maintenance. The Code provides inter alia that “pipework should only be buried when unavoidable. The pipeline route shall be permanently marked or recorded. It must be adequately protected against corrosion and mechanical damage”. It further says that, “Unless otherwise provided with the means to assess the condition of buried metallic pipework, suitable provision shall be made to facilitate periodic leak testing” and adds, “Steel pipe conveying liquid laid in a backfilled trench should be examined for corrosion, or tested in such a way as to establish its continuing integrity, at least once every 10 years. See Code of Practice No 1, Part 3”. This reflected the relevant terms of HS(G)34. Section 6.1 provided further detail about the required protection for vapour phase pipework which I need not quote.

HS(G)34 appears to have caused a doubt among inspectors as to whether paragraph 188 required excavation of the pipework. Dr Fullam explained in his statement:

“Mr Tyllesley identified that the only way of knowing about the continuing integrity of the pipe is to understand its physical state as well as to carry out a pressure test. A pressure test provides assurance that, over the period of the test, the pipe is not leaking but provides no information on the capacity of the pipe to continue to contain the hazardous substance. HS(G)34 at section 188 makes reference to the 'continuing integrity' of the underground pipework which is not demonstrated by a pressure test alone.”

Dr Fullam appears to have regarded inspection as implicit in the term “continuing integrity”.

When he was referred to the Ives-Coville agreement, Dr Fullam expressed the following view.

"If in fact those intentions [Mr Colville's] did not include excavation of the underground section of the riser, and simply examination of the riser pipe above ground and the pressure test, in my opinion that did not comply with the then published guidance HS(G)34."

Calor's view during the hearings was that for the purposes of HS(G)34, a survey for leakage not including excavation was sufficient for vapour carrying pipework.

HSE appears to accept that the interpretation of HS(G)34 was not clear-cut. Dr Fullam acknowledged that since the ICL explosion OC/286/105 has been published to provide clarity. This guidance concerns

"the ongoing integrity of buried, metallic pipework, used for conveying LPG as a vapour or liquid."

The standard to be achieved is clearly set out:

"Buried metallic pipes of poor or unknown condition are re-routed above ground and protected against mechanical damage, where it is reasonably practical to do so.

Where it is not reasonably practicable to re-route above ground, then either –

- the buried metallic pipework should be replaced by buried polyethylene pipework or a proprietary pipework system which should be installed in accordance with manufacturer's*

instructions; or

- the buried metallic pipework (and its corrosion protection) should be examined and assessed to confirm its condition as acceptable following which it should be subject to a scheme of inspection, examination and maintenance to ensure its continued integrity."*

OC/286/105 is quite specific on the subject of enforcement. It provides for the service of an Improvement Notice where there is evidence of buried, metallic LPG pipework in poor or unknown condition or where there is no strategy for inspection, examination or maintenance; and for the service of a Prohibition Notice where there is clear evidence of corrosion.

Why was the problem missed by HSE?

The dangers of corrosion to buried pipework were known to the HSE for many years, as was the danger arising from LPG pipework in unventilated voids. Why then did every inspector who visited Grovepark Mills before 1988 fail to notice the existence of the buried LPG pipework? The reason is, I think, that the national statistics for fires and explosions did not suggest that leaks in LPG pipework were a major safety issue. That was certainly the position of Mr Ives. He saw the critical issue as being the safety and integrity of the tank installation, which he saw to be vulnerable, especially in what he supposed to be an area of criminality. It was this concentration on the tank and the fear of a BLEVE that caused these inspectors to take their eye off the pipework.

Dissemination of information within HSE

The report relating to an LPG explosion in an underground firing range in Daventry in

December 1987 dated 13 January 1988 was not disseminated widely within HSE. It had not been seen by Mr Ives when he accepted Calor's counter-proposals. Mr Tyldesley had not seen it, but he was aware of the hazards attaching to buried metallic pipework.

Mr Tyldesley said that the report of the Daventry explosion would have been entered in a computer database called marcode which was not used by the specialists. The circulation of the report was restricted to a few specialist inspectors. It appeared to have been sent to the Public Utilities Group, but the circulation list showed that it had not been sent to the Fire and Explosion Specialist Group at the Bootle headquarters; so there was no obvious route by which it could have reached the fire and explosion specialists in HSE.

Dr Fullam did not know of the Daventry report until after the ICL explosion. When it was circulated, HS(G)34 had been already published. Since it was an isolated incident, where the cause of failure was an obvious lack of corrosion protection, it would not have prompted him to revise HS(G)34. He agreed that in view of the responsibilities that he held at that time, the failure within HSE to bring that report to his attention represented a systemic failure. The failure to circulate the Daventry report as a high priority represented a missed opportunity to make inspectors better informed and more immediately aware of the hazards of buried metallic pipework and more alert to the dangers that it might represent.

HSE informed the Inquiry that it does not currently have a formal, specific system for monitoring adverse safety trends across the commercial and industrial LPG sectors or sites.

It appears that there are more ways currently in which information can be shared within HSE, but there still does not appear to be a system in place to ensure that important reports, such as the Daventry report, are disseminated more widely and in particular to the relevant officials.

Process safety specialist inspectors are members of an electronic community of interest and practice. They exchange information. There is an annual process safety conference. There is a Fire and Liquefied Flammable Gases knowledge hub and a Process Safety Corporate Topic Group which itself has regular meetings with UKLPG. Incidents reported under RIDDOR meeting the criteria for investigation are placed on the inspection database COIN. There are also regular meetings with utility companies. The Health and Safety Laboratory has been commissioned by the Process Safety Corporate Topic Group to consider how further information can be gathered from existing databases of process safety incidents. The outcome of this review is not known by the Inquiry. I hope that a more reliable and coherent system will be developed than that which operated when the Daventry incident took place.

The part played by Calor and Johnston Oils

Calor

ICL relied on Calor for advice and expertise. Calor had the knowledge to alert all of their customers including ICL to the inevitability of corrosion in metallic pipework. Calor also knew of the hazard represented by unventilated voids in premises where there was an LPG supply. There is no indication that Calor alerted ICL to these risks at any time. Calor have said that ICL did not consult them regularly. They have further indicated that they do not consider it to be inevitable that underground metallic pipework will corrode if it is properly protected when laid and subsequently maintained effectively by its owner. Evidence received by the Inquiry from the former Calor employee who undertook Calor's extensive research programme into this subject has been that, even where pipes were appropriately protected by Denso tape, corrosion has been found. Calor have made a number of representations to the Inquiry concerning the extent of its legal duties in respect of the premises into which it delivers. These are matters that remain the preserve of the proper courts and I propose to express no views on them.

Calor invited me to make a finding in fact that Mr Coville's counter-proposal to Mr Tyldesley's Recommendation 11 went beyond the steps recommended in the applicable guidance, and that at that time there had been no reported problems with the pipework.

Calor also invited me to find that Mr Tyldesley had not referred in his recommendations to the fact that the pipework entered an unventilated void in the basement. Mr Tyldesley was clear

that he was required to make a judgment call on what was the minimum requirement to meet the standard of sections 2 and 3 of the Health and Safety at Work Act and that guidelines never gave answers to all the questions. He disagreed with counsel for Calor that the guidance at paragraph 188 of HS(G)34, which recommended that underground piping carrying liquid in a back filled trench should be examined for corrosion or tested to establish continuing integrity every ten years, prescribed a standard applicable only to pipes carrying liquid. HS(G)34 was for guidance only and he considered that pressure testing every ten years without some greater certainty was not satisfactory as a standard.

Calor referred Mr Tyldesley to LPG ITA Code of Practice in particular to paragraph 6.2.1 (a) which related to pipework carrying vapour below 5 bar, as was the case at ICL, which recommended surveying for leakage at a frequency dictated by the risks associated with its location, pressure of operation and aggressiveness of its environment, and (b) which recommended that above 5 bar, "where practicable", this survey might be a repeat of the pressure test carried out upon installation. Calor's view was that the application of the pressure test suggested by Mr Coville represented a higher standard than that envisaged by the then guidance.

Mr Tyldesley was clear that adherence to the written word of guidance was not sufficient without consideration of wider factors involved. In his view, guidance was just that. It had no legal effect. He was required to use his professional judgement as to what was necessary, taking into account all the circumstances known to him. He considered that

paragraph 6.2.1 (a) required a judgement call depending on the location, operation, pressure and aggressiveness of the environment. I agree with that approach.

Dr Fullam was clear that in his view Calor's counter-proposal, if it did not involve excavation below ground level, was not satisfactory and would not have complied with HS(G)34.

In my view, for so long as Calor contractually accepted no responsibility for pipework beyond the vapour off-take valve, it was at least a tenable position for them to say that the buried pipework was a matter for the user alone. But they could not maintain that position when they agreed to advise and represent ICL in its negotiations with HSE. Mr Tyldesley's recommendation 11 confronted Calor with the question of the integrity of the pipe. Calor knew that it had been *in situ* since 1969. They had not been involved in its installation. They knew nothing about it. The risks of corrosion in underground metallic pipes were by then well known and well understood. These circumstances suggested that at the very least the condition of the pipe should be investigated, whatever the status of the various guidance documents and whatever their meaning. If Calor considered that a solution falling short of excavation would suffice, they should, I think, have described it more precisely and given reasons why they thought that that solution was satisfactory. Mr Coville's counter-proposal was not entirely clear in either respect. However, I accept immediately that it was for Mr Ives, as the responsible officer of the regulatory body, and Mr Tyldesley, whom he consulted on the point, to reject the counter-proposal, if that was their view of it.

Calor have since maintained that examination of the riser referred to in the counter-proposal would have also involved excavation of the soil around the riser. There is no evidence that this was done. If it had been done, it would have shown that there was no protection to the pipework below ground beyond galvanisation. Calor consider that the real issue is whether or not the pipework was corroded. My own view is that the real issue was to establish what the condition of the pipe was at that time. The only reliable way of doing so was to excavate it. If the pipe had been excavated, in whole or in part, it would have been apparent that it had no protection against corrosion other than galvanisation. An informed judgement could then have been made as to the risk that the condition of the pipe created and would create in the future.

Johnston Oils

Johnston Oils were responsible for supplying LPG to the site from 1998. Johnston Oils considered that they would be responsible for the pipes only up to the first stage regulator. When they took over from Calor, they did not carry out any physical examination of the service pipework nor did they propose any steps by which that might be done. They carried out an appropriate pressure test when their first tank was installed, and when its replacement took place. In doing so, Johnston Oils were following the industry standard.

Johnston Oils proceeded on an assumption that the integrity of the pipework was sufficiently vouched by the pressure test.

Uncertainties affecting commercial and industrial users of LPG in the years preceding the explosion

Complexities as between contracts for supply

The terms of the LPG suppliers' contracts varied as to the extent of the respective responsibilities of supplier and customer. It appears that ICL were not fully aware of their responsibility for the continuing integrity of the underground pipework.

Calor consider that there was no reason why ICL should not have been fully aware of their responsibilities for the continuing integrity of the underground metallic pipework. They refer to the booklets and guidance notes for customers to which I refer elsewhere in this report. I do not consider these to have been adequate to alert a customer to the particular risks inherent in ageing buried metallic pipework and in the existence of a void in the pipe run.

I am satisfied that no one in senior management in the ICL group had a clear idea as to where the supplier's responsibilities ended and the customer's began.

Level of understanding of LPG and reliance on the expertise of suppliers

The implications of buried ageing, corroding metallic pipes and their potential leakage were not understood by anyone on the ICL premises. There was little to no understanding of the nature and the properties of LPG. There was no understanding of the vulnerability of buried metallic pipework.

Both suppliers confined themselves to their responsibility for the integrity of the tank, save for carrying out pressure tests on connection to the

customer's pipework. To carry out these pressure tests, they must have used the shut-off valve in the basement area or in the coating shop, since there was no external isolation valve. Those carrying out the pressure tests would have had the opportunity to identify that the external riser pipe entered the building below ground and that the pipework went through the basement. The undesirability of these circumstances was long established within the industry. Both suppliers at the ICL premises were well placed to alert and advise the customer. There was no evidence that either did.

Calor consider their information leaflets, *Health and Safety Information for Bulk Calor Gas Users* and *Guidance Notes for Commercial Customers* relating to the pressure systems regulations provided such information. The first referred to the carrying out of a visual examination of an LPG system and the use of operational tests at least once every five years. The revised version of 1995 contains the comment that "the useful and safe working life of the distribution system, including pipework, regulators and valves will vary with a number of factors such as conditions of duty, environment, standard of maintenance".

In my view, there is nothing in these documents to draw a reader's attention to the issues inherent in the ageing metallic pipework or to the existence of a void. There is no mention of the characteristic behaviour of LPG vapour on an escape nor of its propensity to track the easiest route and accumulate at the lowest level available to it. *Guidance Notes for Commercial Customers* related to Pressure Systems and Transportable Gas Containers Regulations which came into force July 1994. These regulations required owners of pressure systems to know the operating pressures of their systems

and to know that the systems were safe at those pressures. They were aimed at preventing the risk of injury from unintentional release of stored energy from a system containing “relevant fluid”, including LPG systems operating above 0.5 bar. A written scheme of examination was required to cover pipework if a) its mechanical integrity could be significantly reduced in service, for example, by corrosion, erosion or fatigue; and b) the failure and the sudden release of stored energy would give rise to danger. These regulations were succeeded by the Pressure Systems Safety Regulations 2000 (“PSSR”). These regulations concerned a sudden release of stored energy causing a danger to people. I do not regard these as having any special relevance to this case.

The Calor welcome pack was also cited as providing relevant information. The version produced to the Inquiry contained a section called “Looking after pipework”. This makes it clear that the pipework from the outlet of the first stage regulator is the responsibility of the customer. It makes a request that the customer should ensure the above ground pipework is adequately protected and is capable of being inspected, and that care is taken when digging around the vicinity of underground pipework. I do not consider that this document was adequate to alert a reader to the specific risks with which this Inquiry has been concerned.

Johnson Oils acknowledge that they did not identify that the external riser pipe entered below ground; but they consider that they had no responsibility to inspect their customer’s pipework beyond the first stage regulator.

Complexity of legislation and guidance

In what is essentially a self-regulating industry the suppliers are well placed to advise customers as to the standards and regulations that apply to LPG installations.

The regulations applicable to constituent elements of an LPG installation are not to be found in any one source. They apply piecemeal. They generally apply more widely than to LPG alone.

The complexities of the applicable regulations are such that the ordinary user is bound to need help in understanding them.

The industry has acknowledged that there is a need to improve its communications with its customers and assist them with information the better to understand their responsibilities.

Confusion as to which company HSE and others were dealing with at any one time.

There were degrees of confusion as to responsibility for the safety of the installation at the site.

ICL Plastics was the original customer of Calor and was responsible for the installation of the system. Delivery orders for the replacement tank recorded ICL Tech as the customer. ICL Plastics paid for the LPG and re-charged to ICL Tech. When Johnston Oils took on the supply, the bulk tank Agreement was with ICL Plastics. Johnston Oils invoiced ICL Plastics for the tank and ICL Tech for the supply of LPG.

On the incorporation of ICL Technical Plastics, the responsibility for the fixed plant and equipment was transferred from ICL Plastics to ICL Technical Plastics. There was no transfer

of the title to the site. ICL Plastics remained the heritable proprietor of the land in which the LPG pipework was buried.

HSE addressed a number of letters to ICL Plastics although the premises were occupied as a factory by ICL Tech. The managing directors of ICL Tech responded on ICL Tech letterheads.

ICL Tech used the LPG in the industrial processes. ICL Plastics had no day to day involvement in them.

Throughout the period from their incorporation to the explosion, ICL Tech occupied that part of the premises in which the LPG oven was situated. They were the company that used the buried pipework and carried out risk assessments in relation to the plant and equipment in their part of the premises. At no stage did ICL Tech even consider the integrity of the buried pipework or the existence of the void, or the implications if LPG should escape from the underground pipework.

Nor did ICL Plastics. It is not for this Inquiry to make judgments as to the law regarding their respective legal responsibilities. Those are matters for the courts. It is enough for me to say that the uncertainties within the ICL Group as to the responsibilities of the constituent companies were prejudicial to safety.

The companies do not dispute that there may have been confusion regarding their respective legal responsibilities. They have stressed to me that there was no deliberate intention to confuse, cloud issues, obstruct or mislead any person.

The Local Authority

Throughout the period from 1969 until 2004 responsibility for the building legislation and the planning legislation lay with the relevant local authority, namely Glasgow City Council, and its statutory predecessors the Corporation of the City of Glasgow (until 1975) and the City of Glasgow District Council (until 1996).

In relation to the Building (Scotland) Acts 1959 and 1970, it is my view that there was no inadequacy in the building itself, nor in the use of that building for the industrial and administrative purposes carried out by the ICL companies, nor in the manner in which that building was modified or altered, at any rate after 1969. In the case of building control, there was no requirement to take into account the existence of any LPG installation when proposed alterations to the building were being considered.

Strathclyde Fire Service

Strathclyde Fire Brigade records show that Strathclyde Fire Brigade carried out a routine fire safety inspection of the ICL Plastics premises on 5 December 1989 in consequence of which a notice was issued requiring an upgrade of the fire precautions.

Paul McClintock, currently the Group Commander, Operations and Development, for North and South Ayrshire Area of Strathclyde Fire and Rescue, recalled that he attended the ICL premises in 1993 or 1994 when working as a fire prevention officer based at Yorkhill Fire Station, Glasgow. He was a member of a Project Team which was responsible for reviewing, updating and amending existing fire certificates for various premises. The review was being conducted under the terms and

requirements of the Fire Precautions Act 1971. It involved visits and inspections of premises, notifications to owners and occupiers of necessary requirements for fire safety procedures, amendments to fire certificate documentation and the creation of computer assisted design building plans (known as CAD plans).

On 4 October 1993, Mr McClintock issued ICL Plastics with a form FPA4(i) a notice specifying alterations that had to be made to the premises. The alterations schedule referred to the alarm system, signs and notices, and fire fighting equipment. These requirements were low key. On a scale of 1-10 with 10 being a major concern, Mr McClintock rated the requirements for ICL Plastics at 2. ICL Plastics had until 4 January 1994 to comply with these requirements. On 9 December 1993, Strathclyde Fire Brigade received a letter from ICL Tech confirming that the outstanding requirements were complete.

On 20 December 1993, Mr McClintock recorded that an Amended Fire Certificate was being prepared. Although it was not specifically recorded in the case notes, Mr McClintock was of the opinion that he would have visited the premises on 5 January 1994 to deliver the amended certificate. He would have issued it only after touring the premises to ensure that all alterations had been carried out. The amended certificate indicated that the premises were in single occupation and did not include the basement.

A CAD plan was appended to the amended certificate. It showed neither the basement nor the stairwell that ran from the ground floor down to it. The appendix page in the certificate, which included an entry for each floor level, has no reference to the basement.

Mr McClintock did not recall there being a basement. Normally an area such as a basement would be omitted from the relevant plans only if it was unused and permanently sealed off. In these situations the basement would have been considered to be outwith the scope of the fire certificate or not in use. This should have been clearly recorded.

According to Strathclyde Fire Brigade's Operational Technical Note A6, a plan should have indicated the existence of a basement and the basement access. One of the purposes of a record was to assist crews to locate access points. A basement stair access was an essential feature to show on a plan. Had the fire service been aware that the basement was in use for accessible storage, it would have been included in the fire certificate and two means of escape would have been required.

On 3 August 2001, Strathclyde Fire Brigade carried out a routine fire safety inspection of the premises and considered the fire precautions satisfactory at that time.

Strathclyde Fire Brigade also maintained a record under the provisions of the Fire Services Act 1947. The record included a plan of the ground floor. Nine familiarisation visits were recorded by fire crews who attended at the premises between 1991 and 2003. Three of those visits were recorded as a 're-inspection'. A re-inspection was a check of the accuracy of the records held and the purpose of a visit was to assist with fire crew familiarity.

I am satisfied that none of these events had any bearing on the occurrence of the explosion.

Part 7

Chapter 15 – What caused the disaster

The initiating event on 11 May 2004

The seat of the explosion was in the section of the basement into which the LPG pipe entered the premises. Kenneth Murray died there of injuries consistent with his having been at the point of the explosion. He was the only person who could have brought about that ignition, but precisely how that occurred remains unknown. A spark may have been caused by the operation of an unprotected light switch. Some but not all of the wiring had been spark-protected. A rusted and badly damaged cigarette lighter was found in the rubble. It may be that Kenneth Murray lit a cigarette with it. Mr Murray was unfortunately in the wrong place at the wrong time. He was an innocent victim of circumstances. I have already described the detailed circumstances leading to the escape and accumulation of LPG in the basement and to the explosion and collapse of the building.

The causes of the explosion, and the lessons to be drawn, are now fairly clear. As is always the case, hindsight highlights missed opportunities to identify the risk and to take action to avoid it. My recommendations are based on the lessons to be learned.

This Inquiry is not about ascribing blame or fault. Those are matters for the courts. The purpose of the Inquiry is to establish the facts and to make appropriate recommendations for the safety of LPG sites. I am encouraged by the comment of senior counsel for those injured survivors and bereaved families who were represented by Thompsons. In his closing statement he said of his clients:

“Although the evidence was frequently upsetting to them, they were able to gain a clear insight into the cause of the disaster.

We have been instructed to advise the Inquiry that they do feel that the truth of what happened has come out”.

The explosion itself was not the direct cause of death, save in one case. Most of the deceased were working on the second floor of the building. It was the collapse of the building that caused their deaths.

The building did not suffer a “disproportionate collapse.” With an explosion of such severity, the almost complete collapse of the building was reasonably to be expected. Leaving aside the existence of the void, it cannot be said that any inadequacy or deficiency in the original construction of the building, or in its subsequent alteration and maintenance, contributed to the explosion or to the severity of its consequences. There was no significant pre-event damage to the building and no significant deterioration of it by age or use. The construction, alteration and maintenance of the building made it reasonably fit for the purposes for which it was being used. It collapsed progressively as a result of the powerful overpressure that acted upon critical elements of the structure.

The immediate cause of the explosion was the escape of LPG from the substantially corroded underground pipework at the cracked right-angled bend close to the southern wall of the building, the tracking of the escaped gas into the basement of the building at the west end, the accumulation of the gas in the basement to a point where it constituted an explosive mixture in air, and the ignition of that mixture.

The history of the pipe

To explain that immediate cause, it is necessary to examine the history of the installation, management and maintenance of the underground pipe over a period of about 35 years from the introduction of LPG to the site.

The fracture of the pipe occurred because no-one involved in the installation of the pipe and the subsequent raising of the yard appreciated the risks that were inherent in buried metallic pipework. The pipe was not adequately protected against corrosion in the first place. The raising of the yard added to the stress on it.

HSE carried out inspections of the site over a period of about thirty years. Only one of these inspections alerted HSE to the existence and condition of the buried pipework.

On that occasion HSE recommended that the pipe should be excavated. Calor responded to HSE on behalf of ICL Tech. HSE accepted Calor's counter-proposal without questioning whether it would achieve the objective of the recommendation. Whether or not Calor's proposal to examine the riser on exchange of tanks is to be construed as involving an examination of the underground pipe, and whether it was reasonable for HSE to suppose at that time that it did, need not be decided by this Inquiry. What matters is that the recommendation was not followed through. The pipe was not excavated. Thereafter no one thought to ascertain the condition of the pipe. In due course the condition of the pipe was not considered in any of the risk assessments carried out by ICL Tech. Its existence was completely missed.

The key factors having a bearing on the event

(1) Inadequacies in the 1969 works for the laying of the pipework under the yard and its entry into what was then an open area, partially below ground level, within the factory premises.

The underground steel pipework had been galvanised, but it had no other corrosion protection. With one exception close to the tank, the fittings were ungalvanised and had no corrosion protection at all. By 1969 it was known that wrapping galvanised pipes in Denso tape provided added protection from corrosion.

The pipe track was filled with a range of soil types classified as having "aggressive" to "very aggressive" corrosive qualities. The soils were mixed with rubble in-fill that contained large pieces of concrete that bore directly onto the pipe.

As installed, the pipe rose vertically to about 0.45 metres above ground before entering the building horizontally through a bricked-up window by way of a right angled bend. Where the pipe passed through the bricked-up window, it was neither sleeved nor sealed. The lack of sleeving left the pipe unprotected from the brickwork and any building movements. When the pipe was later buried, the absence of sealant provided an easy tracking route, but not necessarily the only one, for any escaping LPG.

The underside of the right angled bend was significantly corroded. It had a crack of about 71% of its circumference. The failure of the bend caused a significant leak close to the entry point of the pipe into the basement.

Under the terms of the contract with Calor, ICL Plastics, under the managing directorship of Campbell Downie, were responsible for the installation of the underground pipework between the tank and the LPG ovens.

Calor's letter of 29 May 1969 noted:

'.....should our quotation be acceptable to you, the galvanised iron pipe, pipe fittings, et cetera, required to connect from the two ovens to the bulk propane supply should be carried out by your own labour force.'

and the notes to the quotation specified that

"it would be the customer's responsibility to excavate and subsequently infill a suitable trench to accommodate the high pressure pipeline from the Bulk Storage Vessel to the main building."

According to a Calor witness, it was likely that if the customer had indicated that he intended to arrange for the laying of the pipework, Calor would have provided a specification and a recommended method of working. No evidence of any such specification or working method has been found. There is no evidence that any specialized technical advice was either sought or given in relation to the laying of the pipework.

Campbell Downie's brother-in-law, Frank Semple, supervised the installation of the underground pipework. It appears that he engaged a subcontractor whose identity is unknown. On 17 December 1969 ICL Plastics wrote to Calor confirming that "our installation conforms to the necessary precautions for tank installations". Whatever those precautions were, they were not met.

Full galvanisation and Denso wrapping would have provided some protection against the corrosive effects of the surrounding soil and extended the safe life of the underground pipework and its fittings; but neither would have protected them from corrosion indefinitely.

After the pipework was installed, no record was kept of the condition in which it was buried. ICL Plastics failed to keep its condition under review.

(2) The raising of the level of the yard in early 1973

This was the next critical event. ICL Plastics appear to have left it to the builders to decide how to carry out the work. It appears that the builders carried out the work without any technical advice. Without the specification or the plans submitted with the application for the building warrant, I cannot say whether the builders were aware of the entry of the pipe into the building.

The yard was raised by using rubble and soil infill and then surfaced with concrete. This buried the LPG pipe where it entered the building. The soil and rubble had a corrosive effect on the now buried riser and the ungalvanised right-angled pipe bend. The risk of corrosion is greater close to a building because of the higher moisture content of the soil in that area, generally from the run-off of rain.

The weight of the soil and rubble and the concrete slab resting directly on top of the riser pipe put additional stress on the right-angled bend where it turned to pass through the bricked-up window. This particular source of stress is consistent with the position of the crack in the pipe. Although the loading on the pipe

was one of the factors that led to the critical event, the right-angled bend, with the remaining pipework, was bound to fail at some point in consequence of corrosion. This is shown by the small perforation found in the pipe about a third of the distance from the tank.

My conclusion is that it is unlikely that those who raised the level of the yard considered what effect that would have on the pipework or whether it should be protected in any way. Their failure to protect the pipe or to seal the entry point at the building demonstrates how little they knew of the properties of LPG or of the vulnerability of buried metal pipework and fittings to corrosion.

Since there was no sealing around the pipework, the burial of the pipework under the new level of the yard provided a means by which LPG leaking from the pipe could track into the building and accumulate there.

Tracer gas tests made after the explosion showed that there was a leakage path below the pipe entry point. I cannot determine the exact path by which the LPG tracked into the building. LPG tracks the easiest route and can permeate through subterranean structures. One cannot assume that if the entry point been sealed it would have prevented the LPG from passing into the building. A suggestion was submitted to the Inquiry that the LPG may have welled up and then, by reason of the building alterations, accumulated in the basement by way of the stairwell. Whatever the exact means of ingress, what matters is that the LPG escaped from an underground corroded pipe, cracked in consequence of external corrosion and a weight bearing load at a point directly outside the unsealed entry of the pipe to the building and accumulated in the basement.

(3) The laying of the steel chequer-plate floor over the open pit area at the west end of the building in 1982.

In 1982 Campbell Downie instructed JGN Reid Brothers Limited (Reid) to supply and install the steel floor over the open pit. Reid built a freestanding mezzanine structure consisting of steel chequer-plate flooring supported on lateral steel beams, in turn supported on steel columns footed on concrete plinths. This extended the existing suspended concrete ground floor to form the despatch area. The ground floor internally was above the external ground level. A wall divided the closed-over pit from the remainder of the original basement area. No mechanical ventilation was installed.

There is no evidence that any of those concerned in these works thought about the LPG pipe in the basement or about the potential consequences if there should be a leakage and accumulation of LPG within the void.

Even before the steel floor was laid, the basement had no mechanical ventilation. Such natural ventilation as there was would be inadequate to disperse an accumulation of LPG. While the construction of the steel floor may have reduced any natural ventilation, it did not create an unventilated void. The void already existed and LPG was capable of collecting at the bottom of it. It was possible that the LPG could have reached a critical explosive mix, even without the presence of the steel floor.

The real significance of the laying of the steel floor was that the LPG pipework, where it entered the building, could no longer be seen or accessed except in the basement. The laying of the floor also made it less likely that a leak of LPG would be detected by smell.

Part 8

Chapter 16 – The responses of HSE and of the industry in the aftermath of the disaster

HSE

Post explosion guidance

After the explosion HSE gave a relatively low priority to the planning of a metallic pipework replacement strategy. HSE considered that an explosion of this kind was a relatively low probability event, that it had to prioritise its resources and that it should develop a replacement strategy in collaboration with the industry.

Discipline Information Notice (DIN) No CD5/059 "Developing an inspection strategy to ensure the ongoing external integrity of buried, metallic, LPG pipework" (November 2004)

This internal technical note drafted by Penny Taylor was issued in November 2004 to process safety and mechanical engineering specialist inspectors. The background note to it records that

"HSE knows of several cases of externally corroded buried, metallic, LPG pipework. Corroded pipework may lead to LPG releases that can accumulate, ignite and explode. Several cases of external corrosion of buried pipework, one of which led to building collapse and personal injury, have been reported to the HSE. This DIN is to promote awareness and provide a timely reminder of the safety precautions applicable to metallic underground pipes carrying LPG as a vapour or liquid".

This notice sets out the comparison with natural gas and explains the Advantica service replacement policy for natural gas lines. It then provides a short summary of the applicable legislation and review of the guidance. It also details an inspection strategy for buried pipework stating that

"the only really effective inspection method currently available is to excavate and visually inspect the sleeve or coating for defects and if possible the external surface of the pipe. For this reason metallic pipework should only be buried when it is unavoidable."

It highlights the limitations of pressure testing since it will not indicate the exact location of a leak nor the condition of the pipework. It also highlights difficulties in the use of gas detecting devices. It recommends that an inspection strategy should be developed by a suitably competent person and sets out the factors to be taken into account in preparing such a strategy. The notice contains a warning that "it is not considered good practice to excavate a live pipe, i.e. containing LPG."

Checking LPG Pipework Leaflet (March 2006)

This leaflet was produced in March 2006 and distributed to LPG users. It clearly explains that the user is responsible for its LPG pipework. It also sets out in plain English questions that the user should consider when checking the nature and condition of LPG pipework. If in doubt, the user is advised to contact the HSE infoline. Few users have done so.

Shuna Powell Report "Industry practice regarding the integrity of buried metal LPG pipework" PE/05/08R 2006 (29 November 2006)

This Report follows on a survey, commissioned by HSE, of about 500 companies with limited knowledge of their LPG and associated buried pipework. In the course of the survey 29 companies were visited.

The findings of the Report showed that there was a serious lack of comprehension amongst users about the dangers of underground metallic

LPG pipes and about the levels of maintenance required, and generally poor knowledge of the relevant regulatory framework.

Those users that took part in the survey were provided with a copy of the Discipline Information Notice (DIN) No CD5/059 of 2004 to which I have referred. It is not clear from the Report what action, if any, HSE took where the state of the pipework was unknown.

OC/286/105 "The ongoing integrity of buried, metallic LPG pipework – inspection and enforcement considerations" (April 2008)

This Operational Circular was directed and circulated to all operational inspectors in Field Operations Directorate (FOD) and Hazardous Installations Directorate (HID) and related to a "matter of potential major concern, namely the ongoing integrity of buried, metallic pipework, used for conveying LPG as a vapour or liquid." Matters of "potential major concern" are defined in OC 18/12 as being "those that have a realistic potential to cause either multiple fatalities or multiple cases of acute or chronic ill-health". This circular advises inspectors on matters to be considered and on the action to be taken during visits to commercial and industrial sites where LPG is used. It specifies the sources of technical advice and support.

It advises that if buried metallic LPG pipework is not protected against corrosion, or if the status of the pipework or its protection is unknown, prompt action should be taken. The standard to be achieved is as follows:

"Buried metallic pipes of poor or unknown condition are re-routed above ground and protected against mechanical damage, where it is reasonably practical to do so.

Where it is not reasonably practicable to re-route above ground, then

either –

- the buried metallic pipework should be replaced by buried polyethylene pipework or a proprietary pipework system which should be installed in accordance with manufacturer's instructions; or*
- the buried metallic pipework (and its corrosion protection) should be examined and assessed to confirm its condition as acceptable following which it should be subject to a scheme of inspection, examination and maintenance to ensure its continued integrity"*

The expectation is that, for initial enforcement, where there is evidence of buried, metallic LPG pipework in poor or unknown condition or where there is no strategy for inspection, examination or maintenance, an Improvement Notice should be served. Where there is clear evidence of corrosion, a Prohibition Notice is appropriate. HSE inspectors have issued four enforcement notices related to underground LPG pipework since the date of the ICL explosion.

HSE involvement in Calor's risk-based strategy for the replacement of buried, metallic, LPG pipework ("replacement strategy")

I shall describe the Calor replacement strategy later in this chapter.

HSE first became involved in the Calor strategy in 2007 when Dr Fullam invited UKLPG to consider underground pipework in domestic premises. HSE was concerned that users did not realise that they owned their pipework and were required to maintain it. As a result

of the ICL explosion and an LPG explosion in November 2006 at a house at Glenspin, South Lanarkshire, caused by a leak from an underground pipe, HSE's concern was the risk of gas entering a building and being ignited.

HSE, UKLPG and members of the industry agreed to develop jointly a risk-based approach to the identification and replacement of pipework most at risk of corrosion. The factors to be considered in developing the matrix were the soil type, the materials used in the pipework, the location of the pipe in relation to the building, whether the entry point of the pipe into the building was below ground, and whether the pipe was sleeved. At that time Calor had been conducting research since 2006, which indicated that corrosion was likely to be greater in sandy soils than in clay soils.

HSL research

All parties hoped to use a model developed by Transco and Advantica (the Advantica model) that I shall describe in more detail later. This modelled the likelihood of the ingress of gas into buildings from natural gas pipes. If HSE and UKLPG could use this model, or an adjusted version of it, the work to develop an action plan to replace LPG pipework that was at risk could proceed more quickly. In December 2007 HSL, through Dr Fullam, agreed to fund and undertake additional work to assess whether the Advantica model could be used for this purpose.

At the end of the oral hearings of the Inquiry Dr Fullam said that, although it was not yet complete, the HSL research suggested that, with some modification, the Advantica model could be applied to industrial/commercial pipework.

He said that he expected that a prioritised list of replacements would be in place between Easter and summer 2009 and that a plan of action would be agreed in the latter part of 2009. He said that the question of resources would have to be considered in parallel with the development of a plan.

Miscellaneous

HSE has improved operational instructions for HSE and LA staff. In April 2005, it issued revised operational procedures. The COIN computer system now provides the standards and support systems to manage follow up visits to premises. HSE will introduce a new competence-related training programme for regulatory and specialist inspectors in 2009.

Calor

Replacement strategy – The research programmes

Advantica research into buried pipework

Advantica has conducted extensive research into the failure mechanisms of underground gas mains. It has developed a mains and service replacement model used in the United Kingdom natural gas industry for metallic mains. HSE has endorsed its methodology.

Calor research into buried LPG pipework

The Calor research into buried LPG pipework was commissioned after the explosion at Glenspin. During the investigation into the incident it became apparent that one of the possible causes was corrosion of the service pipework. Mr Gary Tomlin reported this to a meeting of the Calor Safety Health and Environment Business Management Team. He was then authorised to conduct research into ageing metallic underground LPG pipework.

Calor's research was carried out between November 2006 and February 2008. Its main purpose was to further understanding of the mechanism of corrosion of LPG service pipework; of the factors that affect corrosion and the migration of escaping gas; and of the potential for explosions.

Calor conducted a database survey and determined the number and location of their commercial customers. Calor believe that they have about 8000 commercial customers whose installations predate 1993, and therefore they may have metallic pipework as a part or whole of the system.

The first part of the research was carried out through inspection and, where appropriate, excavation at 500 domestic premises in England, Scotland and Wales where the LPG vessel was installed before 1993. Calor also visited domestic, industrial and commercial sites where, after a report to Calor's emergency service, a Calor engineer had confirmed that a gas escape had occurred from service pipework.

Calor also inspected their LPG distribution networks. They conducted leakage surveys on several hundred installations and had specialist contractors carry out certain excavations.

The research was focused on the material of the pipework, its condition, its routing, and its operating pressure, the corrosion mechanisms, the migration of gas and the means of detecting escapes.

With the information gained from this research, Mr Tomlin developed Calor's pipework inspection strategy and their risk-based replacement programme.

Calor procedure for inspection and replacement Calor-owned pipework

In 2006 Calor introduced an internal procedure for the inspection and replacement of pipework that they own; for example, pipework installed on metered estates. They have begun a programme of work to survey such pipework annually and to replace it where necessary. Where metallic pipework does not require immediate replacement, Calor carry out a risk assessment and prioritise it for future replacement.

Customer-owned pipework

In relation to customer-owned pipework at industrial and commercial installations, Calor are working with UKLPG, other suppliers and the HSE to identify, by means of the risk-based strategy, those installations that are at greatest risk.

Calor have shared the information gained from this research with HSE and with the industry through UKLPG. The HSE, through HSL, is undertaking practical experiments in order to validate Calor's findings on the phenomenon of LPG migration. If HSE's findings are in agreement with Calor's, a risk-based model will be adopted by HSE to identify those installations that are in high risk areas. The consequence will be a prioritised programme of replacement of underground pipes based on risk rather than on continuing inspection.

"Checking LPG Pipework" leaflet

After the ICL explosion, Dr Terry Ritter and Mr Gary Tomlin collaborated with HSE in the development of its *Checking LPG Pipework* leaflet. Calor distributed this leaflet to all their industrial and commercial customers. They also set up a dedicated helpline and website.

After that a reminder letter was sent to customers. For those with installations from before 1992, the letter highlighted the fact that their buried pipework might be metallic and would require inspection and replacement. Calor offered to assist customers with such work.

Technical Memorandum No 84/ UKLPG User Information Sheet No 15

Calor assisted LPGA and HSE in the development of LPGA Technical Memorandum No. 84 (TM84) "Inspection and Maintenance of LPG Pipe Work at Commercial and Industrial Premises". This is now available from the websites of UKLPG and Calor as UKLPG User Information Sheet No 15.

Johnston Oils Ltd

Initial site survey at tank exchange

In 2005 when Johnston Oils became aware of the cause of the ICL explosion, they carried out a site survey at every tank exchange to establish if the installation had steel risers.

Where the standard and design of an installation is unknown, Johnston Oils' current policy is to carry out a site survey and a risk assessment of the pipework. If there is evidence of buried steel pipework, Johnston Oils suggest remedial action. The appropriate remedial action could be to replace it. If the customer is not prepared to accept Johnston Oils' recommendation for remedial action, the tank exchange will not take place.

Site survey of all installations supplied by Johnston Oils (commercial and domestic)

Johnston Oils are now undertaking a site survey, separate from the UKLPG survey to which they have also contributed, of all installations, both commercial and domestic, to which it supplies.

They intend, on completion of the survey, to share the results with all their customers. This survey is also separate from the procedure that they now enforce at tank exchange. Johnston Oils are therefore systematically examining every installation to which they supply gas. They were about halfway through this programme in October 2008. They expect to complete it by July/August 2009.

Assistance to users

Johnston Oils respond to requests for technical information and advice from SMEs by carrying out a site visit which may include a risk assessment. They make an accurate record of the bulk vessel and all pipework at the time of installation, or at a tank exchange and after all annual inspections.

Their policy is to liaise with their customers when an agreement is entered into and regularly throughout the contract. They issue the HSE leaflet *Checking LPG Pipework* to their customers.

UKLPG and LPGA

Checking LPG Pipework leaflet

In 2005-2006 the LPGA worked with HSE and other parties to produce the HSE leaflet *Checking LPG Pipework* to which I have referred. In 2006 about 65,000 copies of it were distributed by LPG suppliers to their commercial and industrial customers. Telephone enquiries to the HSE Information line and to the LPG suppliers were lower than expected. Several LPG suppliers have repeated this exercise.

Desktop exercise

LPG suppliers carried out a desktop exercise in 2007 to estimate the proportion of domestic bulk

installations that could present a high to medium risk. The estimate was based on the age of the installation, the pipework material and the pressure under which the system operated.

In early 2008 survey documentation was distributed to all LPG suppliers to help them to identify which of their domestic bulk installations might be at higher risk. The survey material is now being interpreted by LPG suppliers.

Draft safety card

At the same time UKLPG provided a draft gas safety card to all LPG suppliers for distribution to users or for incorporation in their own publications. The card reminds the customer of the actions to be taken in an emergency, raises CO₂ awareness and stresses the need to employ CORGI-registered installers.

Technical Memorandum 84/UKLPG user information sheet 15

LPGA Technical Memorandum No 84, now UKLPG User Information Sheet No 15, *Inspection and Maintenance of LPG Pipework at Commercial and Industrial Premises*, was published on the UKLPG website in March 2007.

It outlines the need for pipework owners to inspect LPG pipework and maintain it in a safe condition. It advises that an inspection strategy should be drawn up based on a risk assessment of the system. It describes the factors to be considered in the risk assessment, such as the phase of the LPG, the location of the pipework, the routing of the pipework and its point of entry into the building. It deals with the subsequent risk categories and gives examples of risk strategies that may be applied. It does not highlight other factors that have since been found to be relevant, such as soil type and

surface cover. At its conference in April 2008 UKLPG held a seminar on the subject.

Codes of Practice

UKLPG Codes of Practice (CoPs) are reviewed routinely every three years. The most recent revision is to Code of Practice 1, Part 1 (January 2009).

UKLPG has redrafted CoP 22 to take account of revised guidance regarding checking underground pipework. The redraft is currently out for consultation.

The proposed revisions will reinforce the recommendations that pipework should always enter premises above ground level; that pipework should not be installed in unventilated spaces; that all systems should incorporate an emergency control valve; that buried pipework should not be metallic, and that buried pipework should be subject to risk assessment and an inspection and maintenance strategy.

UKLPG had a meeting with the IGEM, along with Calor and Advantica, to discuss simplification of the codes of practice that apply to LPG pipework in all uses, including UKLPG CoP 22, IGEM UP/1, TD3 and TD4. The objective is to remove duplications and to remove all doubt as to the extent to which the various Codes apply.

Involvement in Advantica/Calor model

Working closely with HSE, the LPG industry has been reviewing LPG installations in order to produce a "risk matrix" by which those responsible for underground service pipework can understand the risks associated with it and identify the timescale by which they should replace it.

Shell Gas Limited (SGL)

SGL has been working along with other members of the UKLPG and the HSE on the development of the *Checking LPG Pipework* leaflet. During 2006 and 2007 it too sent copies to all its industrial and commercial customers. At the same time SGL supported the development of User Information Sheet 15 with other suppliers and with HSE. Its management has consulted with its engineers and commercial staff on the problem of raising awareness of these documents among its users.

In 2007, SGL undertook a desktop exercise to determine how many customers in the domestic market sector might have pipework at risk as a result of the material used and the operating pressure.

In July 2008, SGL as part of Shell's global Safety Day campaign, briefed all staff on the question of pipework integrity. It appears that this was primarily aimed at domestic customers.

SGL is a participant in the development of the Advantica risk-based approach to steel pipework replacement.

Part 9

Chapter 17 – LPG safety: an overview

[1] Introduction

In this part of the Report I shall examine in general terms the weaknesses of the regulatory regime that this disaster has exposed and set out the general principles on which, in my view, a proper safety regime should be based.

Suppliers and Users

The contractual arrangements

In this part of my Report, I use the terms “user” and “supplier” in a non-technical sense; that is to say I do not use these expressions as they are defined in the GSIUR 1998. By user I mean the party who uses the LPG in its appliances, whether for manufacturing, heating or other purposes. By supplier I mean the retailer who fills the user’s tank.

In most cases, the supply of LPG is a matter between supplier and user alone. In such cases the LPG supplier normally owns the tank and provides the tank as part of the overall supply contract. The extent to which the supplier owns the associated pipework varies. I deal with this problem at a later stage in my recommendations. There are however industrial sites where the LPG user owns the tank and is therefore able to buy LPG from any one of a range of suppliers at the best available price.

In most of the discussion that follows I shall speak of the straightforward situation where there is a single supplier and single user and I shall confine my discussion and recommendations to the case of an LPG supply to commercial and industrial premises. My understanding is that in LPG installations at domestic premises, with which this Inquiry is not concerned, it is common for the supplier to own the tank and the pipework as far as the second stage regulator, although this practice is by no means uniform.

In the ensuing discussion therefore I shall not deal specifically with the exceptional cases where there is an LPG supply to metered estates, with multiple users and a managing landlord or system operator. In such cases either the supplier or the managing landlord or system operator assumes responsibility for the LPG pipework in order to avoid the confusion that would result if responsibility were to be spread among the individual users.

There is also the exceptional case of liquid filling installations, such as auto gas fork lift truck filling installations where the normal arrangement is that the supplier retains ownership of all safety-critical items such as pumps, dispenser, filling gun and non-metallic hoses.

The user side of the industry

One of the most notable features of the industry is the variety and diversity of the users. Although almost every major supplier has among its customers one or more major users, the majority of the users are small to medium sized enterprises, almost all of whom would regard LPG as simply another utility of which to make use in the course of their business. This diversity has considerable implications for safety. It points to the need for a tighter and clearer safety regime.

In terms of the COMAH Regulations, top tier sites, having an inventory of more than 200 tonnes of LPG, must prepare a Safety Report demonstrating that a Major Accident Prevention Policy (MAPP) has been properly implemented, that adequate safety and reliability have been incorporated into the design, operation and maintenance of the facility, that emergency plans are being prepared and that sufficient information has been given to the competent

authorities to make decisions (COMAH Regulations Schedule 3: cf *A Guide to the Control of Major Accident Hazards Regulations 1999*, HSE books, L111, 1999). For lower tier sites, having an inventory of more than 50 tonnes of LPG, the COMAH Regulations require the preparation of a MAPP to provide a statement of senior management's commitment to providing an organisation that can achieve a high standard of major hazard control (COMAH Regulations, Schedule 2).

The preparation of MAPPs and safety reports are demanding tasks requiring an effort commensurate with the hazard potential of the site. However, the great majority of LPG users are not subject to these requirements and, such is their diversity, the achievement of a satisfactory standard of safety may be difficult to secure. Such users are subject to health and safety duties under MHSWR, PUWER, DSEAR and PSSR. Their obligation to prepare a risk assessment is much less demanding than the obligations incumbent on the operators of COMAH sites; but, as this case has shown, even a small LPG site can suffer a major disaster.

The uncertain extent of communication between supplier and user

It has clearly emerged from the Inquiry that at present the degree of communication between supplier and user may vary considerably. Much depends on the size and technical resources of the supplier and on the degree of commitment to safety on the part of the user. In my opinion, the effective flow of information and advice from supplier to user cannot be allowed to remain on this uncertain basis. In the following chapter I make certain proposals with a view to having this put on a more formal and rigorous basis.

The view of the industry

Although only two suppliers were core participants, I am satisfied that the view of the industry on any relevant topic, where there is such a view, has been reflected in the evidence contributed by UKLPG. Where there appears to be no industry view, or where there are differences in view within the industry, I have mentioned that specifically in discussing my recommendations.

The contribution of Mr Sylvester-Evans

It is a pleasure to acknowledge the help that Mr Rod Sylvester-Evans has given to the Inquiry. His evidence has provided me with a valuable indication of the direction in which the industry should travel in its pursuit of the unattainable ideal of absolute safety.

Mr Sylvester-Evans' conclusions have been generally accepted by the core participants. His recommendations, subject to minor matters of detail, seem to me to make good sense and to provide a pragmatic solution. They have the considerable merit that they can be implemented within the existing statutory framework. Although my own recommendations do not coincide with his, I base them largely on Mr Sylvester-Evans' template and, in so doing, acknowledge my considerable debt to him for his clear-sighted view of the issues.

[2] My preferred approach

The need for a coherent response

The effort that went into the retrieval of evidence from the site of the disaster and the expertise that was enlisted to discover the causes of the disaster will be largely in vain if this Inquiry does not lead to a coherent programme of action that will minimise the risk of a recurrence of such an event. Much of the talk at this Inquiry

was to the effect that my recommendations should ensure that a disaster of this kind will never happen again. Ensuring that such a disaster does not happen again is beyond the reasonable expectations of any set of recommendations, however well considered; but the aim must be to minimise the risk so far as can be done. This requires a concerted and logical programme of action.

Some basic principles

I make all of the recommendations that follow in Chapter 10 with the fundamental objective of ensuring that every LPG installation is safely and properly installed, safely and properly managed by the user and safely and properly overseen by the regulatory bodies having responsibilities in respect of it.

In the achievement of that fundamental objective, there are certain subsidiary principles. In my opinion, pre-eminent among these is the principle that, whatever may be the duties and responsibilities of regulatory bodies and of suppliers, the primary responsibility for LPG safety lies, from first to last, with the party who creates the risk. That means, in effect, the site user. It is the user who brings onto the land a highly volatile and dangerous gas. No amount of responsibility for safety on the part of any third party can ever be said to absolve the user from that primary responsibility. This principle has considerable relevance in the present case. I have little doubt that ICL's unenthusiastic approach to LPG safety, at any rate in Mr Frank Stott's time, was allied to the idea that safety measures were to be taken only at the prompting of HSE. That is a fundamentally fallacious attitude that should have no part in any modern safety regime.

General conclusion

The Inquiry has left me in no doubt that the present safety regime is inadequate. The question then is what approach should be taken to improving it. My general conclusion is that progress in this field should, wherever possible, proceed on a basis agreed between HSE and the industry, which means in effect UKLPG, and that a heavy-handed regulatory approach is to be avoided except where it is essential. However, a consultative approach and a co-operative spirit will be pointless if progress is not made with an appropriate sense of urgency.

More specifically, my approach proceeds on the view that the regulatory authorities, and HSE in particular, should start from a proper knowledge and understanding of LPG risks; should achieve a standard of inspection and enforcement that is appropriate to the seriousness of these risks; should be consistent in their approaches to enforcement; and should have clearly defined lines of demarcation between their respective spheres of competence.

Lastly, my recommendations proceed on the basis that there should be no barriers to the fullest possible sharing of all health and safety knowledge relating to LPG between the regulatory authorities, the suppliers and the users.

I have tried throughout my recommendations to make proposals that are practical and readily capable of implementation without unreasonable cost. Nevertheless, I recognise that in relation to my proposed metallic pipework replacement programme, the cost implications may well be significant. Having regard to the potential risks that now exist, I do not consider that on this aspect of my recommendations cost can constitute a reasonable ground of objection.

Table - Comparison of Gas Incidents with some Everyday Risks			
Cause of Death	Annual Risk of Death	Annual risk per Million (approx)	Ref Source
Men aged 65 to 74	1 in 51	27,800	1
Cancer	1 in 387	2,600	2
Injury & Poisoning	1 in 3,137	318	3
All accidental causes	1 in 4,064	246	3
All forms of road accidents	1 in 16,800	60	3
Fire and flame	1 in 125,000	8	4
Fatalities to workers	1 in 125,000	8	5
Homicide	1 in 166,700	6	4
All Gas incidents (domestic)	1 in 2,210,000	0.45	6
Gas incidents – CO poisoning	1 in 2,840,000	0.35	6
Gas incidents – fire & explosion	1 in 10,000,000	0.10	6
Struck by lightning	1 in 18,700,000	0.053	7

Table References: -

1. Annual Abstract of Statistics (2001) – Health Statistics Quarterly – Summer 2001
2. Annual Abstract of Statistics (2001) – England & Wales - 1999
3. Annual Abstract of Statistics (2001) – UK -1999
4. Annual Abstract of Statistics (2001) – England & Wales – 1991-2000
5. HSC Health & Safety Statistics 2002/03 to 2006/07, based on an average fatality rate of 0.8 per 100,000 workers per year.
6. From HSE – Gas Safety Statistics – 1997/98 to 2006/07 (Domestic related, averaged over the UK population and includes natural gas and LPG)
7. Office of National Statistics (2001) – England & Wales 1995 to 1999.

Putting LPG safety in context

Notwithstanding its naturally hazardous qualities, the use of LPG in industrial, commercial and domestic installations is, in general, safe. One cannot assert the proposition with any greater certainty than that since the only available data are derived from “piped” gas supplies, an expression that comprehends both natural gas and LPG, and does not disaggregate gas incidents in industrial and commercial installations from those in domestic installations.

The risk table gives the opportunity for a comparison of gas incidents with a variety of everyday risks. The table categorises three sets of data in relation to three categories of gas incidents, namely all gas incidents (domestic); gas incidents – CO poisoning; and gas incidents – fire and explosion. The table shows that, in general, the risk of gas explosions is small in relation to all but one of the other everyday risks described in the table.

This table adequately establishes the unlikelihood of the occurrence of an LPG explosion in terms of statistical probability. But the worrying question, of course, is not how likely it is that an LPG explosion will occur, but what may happen if it does.

[3] Weaknesses in the present system

This Inquiry has highlighted, in stark form, the following nine aspects of the present LPG regime that give rise to significant risks.

The problem of metallic pipework

It has become clear from this Inquiry that the HSE and the suppliers have only the most uncertain estimates of the scale of the problem of metallic underground pipework.

The clear and overriding hazard which this disaster has highlighted is that there is, to an extent that is yet to be exactly determined, a considerable amount of underground metallic LPG pipework whose state of integrity is unknown. Since the use of polyethylene pipework has been standard practice for over twenty years, it is likely that existing metallic pipework has been subject to a long period of corrosive attack. None of this pipework is subject to any systematic regime of inspection and maintenance; nor subject to systematic data recording. As matters now stand, there is every possibility that a similar disaster could occur again.

Responsibilities of user and supplier

Two main problems arise from the relationship of the user and the supplier. The first is that there is no uniformity of practice in the demarcation of responsibility for LPG installations between them. Most suppliers seem to accept responsibility up to the first stage regulator,

but at least one of the major suppliers, Calor, accepts responsibility only up to the vapour off-take valve.

The second problem is that since the supplier disclaims responsibility for the pipework beyond the point stipulated in the supply agreement, and since the industry considers that the supplier has no obligation to inspect the user's pipework before supplying to it, there is no safeguard to prevent a user whose installation is dangerous from accessing supplies of LPG.

Lack of systematic record keeping of all installations

This inquiry has demonstrated that one of the major weaknesses in the current regime is that no user is obliged to keep comprehensive records of all matters relevant to the safety of it; for example, design drawings, plans, maintenance records and the like.

The problem of awareness of risk

There are also weaknesses in the appreciation and prevention of LPG risks. The problem shows itself in several ways. For the bulk LPG user, the LPG supply is only ancillary to the user's main purpose and effort, and is not at the forefront of the user's attention. There may also be a tendency for the safety of buried pipework to be overlooked. The problem of a lack of awareness of LPG hazards may be more acute in the case of small and medium sized enterprises.

As a result of this failure in awareness of risk, it is possible for pipework for this hazardous product to be designed and laid by persons who have no particular expertise in LPG safety and only a meagre appreciation of the risks. As this Inquiry has shown, it is possible for changes

to be made to the physical surroundings of an LPG installation, like the raising of the yard and the creation of the basement void in this case, without there being any consideration of the implications for LPG safety. This Inquiry has also shown that the user of an LPG installation may entirely overlook the safety considerations affecting buried pipework and that a formal risk assessment may be carried out by persons, however conscientious and well-intentioned, who lack a proper awareness of the risks that buried pipework creates.

It follows from these possibilities that a lack of awareness of the safety considerations may also indicate a lack of knowledge of the potential consequences of an escape of LPG and in particular the potential consequences of an explosion. Such lack of awareness of risk leads inevitably to failures in the management of risk and in the taking of measures to mitigate it; to failures in the proper response to safety incidents, and to failures in education and training of staff in the appreciation and management of risk.

These problems have been highlighted since the occurrence of the disaster in the HSL report *Industry Practice Regarding the Integrity of Buried Metal LPG Pipework* (PE/05/08R: 29 November 2006). From a sample of 58 LPG sites that had buried metal pipework, HSL found that documentation and records relating to the buried pipework system were rare; that generally the understanding of the levels of maintenance required for it was poor; that some sites had never conducted an inspection of it, had no idea where to obtain information, and had not considered any risk assessment relating to it; and that on other sites that had procedures in place, these procedures did not extend to preventative

and maintenance programmes. Of the companies that felt that they had a maintenance programme in place, many of the programmes were unlikely to be sufficient to assess the integrity of the pipework. Few companies had knowledge of what was done by sub-contractors brought in to maintain it. Before the visit by HSL, many companies believed that the responsibility for the maintenance of it lay with the tank provider and/or the LPG supplier. HSL also found that the majority of the users visited did not know where to find information relating to the inspection and maintenance of such pipework and that some felt that if the PSSR did not apply to them, then they did not have to check the integrity of the buried metal pipework at all.

In its recent Operational Circular *The Ongoing Integrity of Buried Metallic LPG Pipework – Inspection and Enforcement Considerations* (OC286/105, version 1, updated to 12 May 2008), HSE give priority to alerting its own inspectors “to a matter of potential major concern, namely the ongoing integrity of buried, metallic pipework, used for conveying LPG as vapour or a liquid.”

Since the HSL study on which its 2006 Report (*supra*) is based also found that the quality of ventilation at some LPG sites was questionable, even when the users believed that the area was ventilated, there is every reason to conclude that some LPG users have an inadequate understanding and appreciation of LPG hazards. That fact alone is cause for serious concern. While there is such a lack of appreciation, it is little wonder that management weaknesses are reflected in a failure to appreciate the existence of hazard, let alone to deal with it by effective programmes of monitoring and maintenance.

My findings in fact demonstrate that each of the events that contributed to the causation of the disaster resulted from a wholly inadequate understanding of the nature of LPG risks and a wholly inadequate appreciation of the nature and extent of the hazards and risks associated with the installation, together with a safety culture in which LPG risk was not given any proper degree of priority.

Inadequacies of the risk assessment system

As this case vividly illustrates, compliance with the risk assessment provisions of MHSWR and DSEAR gives only a limited assurance of the safety of an installation. It is possible for what may look like a full risk assessment to miss a significant risk, as happened at Grovemark Mills.

Unregulated entry to the LPG market place

Anyone who can find a source of LPG can enter the market as an LPG supplier and is under no obligation to join UKLPG or to abide by its codes of practice. In an industry that deals with such a hazardous product, such possibilities are not, in my view, conducive to safety.

Demarcation of responsibilities of HSE and local authorities

The Inquiry has brought to light a lack of clarity, which I did not expect, as to the respective provinces of HSE and local authorities in relation to safety standards in industrial and commercial premises in which there is an LPG supply.

In terms of the Health and Safety (Enforcing Authority) Regulations 1998 HSE is, in general, the enforcement authority for industrial premises, hospitals, educational establishments and

construction sites, whereas the local authority environmental health departments are the enforcement authorities for other premises such as retail sites and offices.

There is a complication relating to responsibility for inspection and enforcement of the structural safety of buildings. It appears that in relation to the safety of the building, from the point of view of structure and layout, the responsibilities of HSE and the buildings authority may on occasions overlap. The respective responsibilities of HSE and local authorities in relation to the structural safety of buildings can be ascertained from a careful reading of the legislation and the relevant regulations and circulars; but only with difficulty.

In this case, the demarcation of responsibility between HSE and the local authority building control departments is prescribed in the HSE Operational Circular OC404/21 (*Structural Safety: Action by Inspectors Including Liaison with Local Authorities*, 31 January 1991) and HELA Local Authority Circular No 82/2 (Revd May 2000, review date May 2005).

For new buildings and for the initiation of remedial action for structural instability, responsibility lies with the local authority building control department. In accordance with section 1(3) of the HSWA, HSE enforcement officers "should address the structural safety of existing buildings." This expression is also used in HELA LAC 82/2 (*supra*); but in the earlier HSE Operational Circular OC404/21 it is said that "HSE inspectors are more often concerned with safe systems of work than with structural safety of existing buildings, although HSWA section 1(3) explains that risks to safety and health includes risks attributable to the condition

of the work premises therefore inspectors have a role to play on which guidance is given below." The guidance referred to in OC404/21 (*supra*) is to the effect that where, in any HSE-enforced premises, the building or structure is inaccessible to the general public, it may be appropriate for matters of structural danger to be handled by HSE. The OC says "Where the stability of a building is put at risk by the work activity in that building, then the inspector should enforce under HSWA section 3 or probably section 2 as appropriate. The local authority should be informed of action taken in this respect." The guidance in LAC 82/2 is broadly to the same effect but it refers to the inspector as being the "enforcement officer" and that may be either an HSE or a local authority inspector. LAC82/2 also refers to the MHSWR and the Construction (Health, Safety and Welfare) Regulations.

At Grovepark Mills, HSE had regulatory oversight and responsibility for enforcing questions of building safety as they related to the workplace.

Regulatory weaknesses

It appears that in this case and, I think, more generally, there has been a failure by HSE to institute a prioritised system of inspection of older LPG installations having buried pipework; an insufficient training of inspectors in LPG hazards and risks, and a failure to ensure the effective follow-up of inspections that have shown up risks on an LPG site.

Lack of communication

The final area of weakness that I have identified is in the lack of effective communication to users of the risks inherent in LPG installations, and particularly in buried pipework, and in LPG escapes; a lack of effective sharing

of knowledge of risks between users and suppliers; and a lack of prompt and effective notification of LPG incidents, and of the lessons to be learned from them, to users and suppliers.

[4] The urgency of the matter

In my opinion, there is no time to lose. I have already described the HSE response to the tragedy. The corrosion of the pipe was identified at an early stage in the investigation of the explosion. Five years later, HSE has not produced a coherent action plan to deal with underground metallic pipework and the risk of a recurrence. HSE's reaction to the tragedy has been based on an assessment, made from certain data on gas explosions, that the risk of a recurrence is remote. That assessment has underlain its stiffly bureaucratic response to the tragedy and its apparent lack of any sense of urgency. When asked what priority HSE had attached to producing an action plan Mrs Sandra Caldwell said:

"We did give it priority but I would want to put it into context, that there were other aspects of our work that also had a priority...but if you actually look at the track record for LPG, the probability is a low probability."

"So, yes, we have applied priority. We are taking work forward, but we would have had other areas of priority as well outside LPG that we would balance this work with."

"...if you look back, there were probably times that we may have been able to speed this up but equally we were working in partnership with others who also had timetable pressures as well."

I am sure that HSE's response has been informed by a genuine appreciation of the need for a programme of action; but I think that its approach in the aftermath of the disaster has been misguided in three respects.

The first and most fundamental is that although the available evidence suggests that the overall probability of an LPG explosion is low, the real worry in this case is as to the degree of probability of leakage arising from a failure in buried metallic pipework. That is an avoidable risk that arises from the inevitable process of corrosion. The assessment of it is entirely dependent on knowledge of the age of the pipework, the extent, if any, to which it is protected and the physical surroundings of the pipework, including the soil conditions and the likelihood of impact damage. Where any of these factors is unknown, it follows that the extent of the risk is unknown, too.

The second difficulty in HSE's approach is that its own work in this field has not advanced our knowledge of the number of LPG installations in the United Kingdom with underground metallic pipework. So the scale of the problem has yet to be assessed.

The third difficulty is that since the assumed low-probability event of an explosion may, in any individual case, have catastrophic consequences, a sense of urgency would be an appropriate response to the serious issue of public confidence that this disaster has raised and would be a sensitive response to the depth of feeling on the subject in the west of Scotland.

[5] Basic principles of a modern safety regime

In my opinion, it is essential that reform in this area should be practical and practicable;

should avoid the imposition of unnecessary burdens on the regulatory body and on the industry; should be readily understood by all who have an interest in LPG installations; and should be capable of flexible adaptation in the light of experience and advances in scientific knowledge.

The urgent priorities for action are that there should be a complete awareness among all who are involved with LPG installations of the hazards and risks that are inherent in ageing installations and in particular in those that have underground metallic pipework. It is essential to establish a uniform regime that can be applied to all installations within the wide range of sites and users. It is also essential that users should be educated in the risks and in their responsibilities and should know where the responsibilities of supplier and user begin and end.

It is also vital that action of this kind should extend to an examination of the buildings into which LPG has been introduced.

I therefore propose that there should be a clear and concerted action plan and that it should be implemented promptly and in a co-ordinated way.

[6] The proposed action plan

For reasons that I shall give in detail, I consider that there should be an action plan for all bulk LPG installations in commercial and industrial premises in the United Kingdom and that the plan should be carried out in four phases.

The first and most urgent priority is to identify those sites where there is underground metallic pipework between tank and appliance and thereafter to replace all such vapour phase

pipework, on a systematic and prioritised basis, with polyethylene.

Along with this there should be an early inspection of all buildings that have an LPG supply in order to identify any hazardous features that arise from the design and layout of the building or are inherent in the layout or the condition of the service and installation pipework.

The next phase, which I think should run concurrently with the pipework replacement programme, is to establish a permanent and uniform safety regime governing the installation, maintenance, monitoring and replacement of all LPG systems, including the establishment of a uniform rule for the demarcation of the responsibility for any installation between supplier and user. This should proceed on the principle of life-cycle integrity, that is to say the principle that the integrity of the system for safe operation should be understood and safeguarded at every stage in the life of the system from initial design to ultimate decommissioning.

Next, there should be continuing and planned development of the safety regime, particularly in relation to the use of polyethylene pipes.

Lastly, there should be a permanent system by which safety questions will be reviewed and dealt with on an industry-wide basis, by which advances in the knowledge and understanding of safety questions will be communicated effectively within HSE and from HSE and UKLPG to suppliers and users alike and by which the areas of regulatory responsibility between HSE and local authorities will be clarified.

Chapter 18 – The action plan

PHASE 1 – THE URGENT PROGRAMME OF PIPEWORK REPLACEMENT AND ALTERATIONS TO BUILDINGS

An urgent programme of replacement of buried metallic pipework

Terms of reference

The action plan that I propose in this chapter relates only to buried metallic pipework carrying LPG in vapour-phase. Much of what I say would apply to such pipework carrying LPG in liquid form. That however is covered by a separate safety regime and consideration of it is, in my opinion, outwith my terms of reference.

Is replacement essential?

It is a basic truth that all underground metallic pipework, even if it is protected, will inevitably corrode. Protection of the pipe, before it is buried, by means of taping, galvanising and the like is not a sufficient solution. Even if the means of protection are applied with complete efficiency, such a measure merely postpones the inevitable day when the pipe will fail. Related to this problem is the fact that in any given case the present condition of an underground metallic pipe that has been protected in this way cannot be accurately assessed without excavation and examination. Metallic pipework, even non-ferrous pipework such as the copper sections that are used in some installations, has only a limited life. Protective measures, therefore, even if applied effectively, merely defer the risk.

Where the pipework has been given some form of protection, such as a protective sleeve, a wrapping of Denso tape or a coating of some kind, it is reckless to assume that the protection has been carefully and effectively applied. There is, for example, a right and a wrong way to wrap a pipe with Denso tape. Furthermore,

conditions on the site may make it difficult for protective measures to be applied effectively. In cases of this kind, even when the date of burial of the pipe is known, it cannot be assumed that the anti-corrosion protection will be effective for the normally to be expected period.

The Inquiry has considered various options to monitor or to protect buried pipework.

Pressure testing of underground pipework will identify if there are any existing leaks in the system, but will achieve little else. A satisfactory pressure test says nothing about the condition of the pipe other than the fact that at the moment of the test it is not leaking. That is no safeguard. That, I think, was the mistake made when the Ives/Coville compromise was reached in this case.

Of the options short of replacement that have been considered at the Inquiry, cathodic protection is the likeliest. It is of little value in new piping systems when the better option of polyethylene is available. Cathodic protection of an existing system is not, in my view, a desirable option. It necessitates the partial excavation of the pipe. Since it is in the excavation that the bulk of the cost of such an operation is incurred, it seems pointless to excavate in order to apply cathodic protection when excavation gives the better opportunity of replacement. Moreover, since the use of such pipework has been obsolete for twenty five years or more, the cathodic protection would probably be applied to pipework that was already degraded. A further consideration is that in the common configuration where there is buried polyethylene pipework with steel risers, cathodic protection would have to be applied separately to each riser, which would double the cost. I conclude therefore that the proposed

action programme should be based upon a commitment to the complete replacement of all underground metallic pipework with polyethylene, and to nothing less than that.

The responsibility for this work should rest on the LPG user and should be mandatory.

This will be a major undertaking that will require commitment and co-operation on the part of users, suppliers, UKLPG and HSE.

Identifying the scale of the problem

The first priority, in my view, is to identify the sites where underground pipework is known to be, or may be, metallic, whether protected or not. It is only with that knowledge that there can be a prioritised programme of replacement. For this purpose, the primary duty of inspection and, if need be, replacement, must rest on the site owner.

Where inspection short of excavation fails to establish the nature of the underground pipework and where the date of installation is either unknown or is a date at which the use of metallic pipework would have been a possibility, it would be irresponsible, in my opinion, to make any optimistic assumption as to the current condition of the pipework. If the pipework is metallic and is unprotected, it may survive intact for 30 years; but in any individual case that period can be much less. The quality of workmanship in the installation, the soil conditions and impact damage are all reasons why the safe working lifetime of an unprotected metallic pipe may be considerably less than 30 years. On the other hand if the metallic pipework has been protected, one cannot be confident that the protection was effectively applied or, even if it was, that it continues to be effective.

I conclude therefore that if it is known that the underground pipework is metallic, the only safe course is to replace it with polyethylene. If there is no reliable information as to the nature and condition of the pipework, the only safe option is to excavate it and, if it is found to be metallic, to replace it with polyethylene.

A prioritised programme

My conclusion is that complete replacement of underground metallic vapour phase pipework with polyethylene is the right solution; but a replacement programme has to be practicable. The immediate replacement of all underground metallic pipework is unrealistic.

A realistic replacement strategy must be to identify the highest risk cases and deal with them as a matter of extreme urgency and to have a rolling programme of prioritised replacement in all other installations, some of which may have to be advanced in priority as the programme progresses. This is a practicable option only if there is a reliable means of identifying and measuring the risk.

It cannot be said that at the moment there is a fully developed risk assessment model capable of immediate implementation. However, there is good reason for the optimistic view that such a model will be available in the near future. In an earlier chapter I have referred to the research programme instituted by Mr Tomlin under the auspices of Calor. In my opinion, Mr Tomlin's is a sensible programme that may reasonably be expected to provide a workable basis for a reliable risk assessment model. In essence, this is a simple risk ranking method based on a number of factors affecting the corrosive power of the particular soil type in which the pipe is embedded.

For the high risk sites, the priority is immediate and urgent. In relation to those sites that are of a lower priority, I recommend that, on the lines of HSE's own internal guidance in OC 286/105, the site owner should adopt an inspection and maintenance strategy for buried metallic LPG pipework to monitor its condition pending replacement.

The problem of steel risers

Since it became standard practice to use polyethylene for buried pipework, and in view of the vulnerability of polyethylene to impact damage, it has been common practice to install steel risers. This however has raised a problem, because the riser near to the building goes through soil of a higher than normal moisture content and is therefore in the area of greatest susceptibility to corrosion.

It is essential, in my view, that the pipework replacement programme should extend to the substitution of polyethylene for steel risers. That will raise two considerations; namely the vulnerability of polyethylene to impact damage and its tendency to degrade in ultra violet light. For these reasons, when polyethylene risers are substituted for existing steel risers, they should be protected with a glass reinforced plastic sleeve.

This recommendation raises a serious practical problem. I have received convincing evidence that any replacement programme will be hindered by the shortage of competent personnel. The problem is to draw up a prioritised programme for the replacement of risers that will be practicable and of the greatest effectiveness.

I have come to the conclusion that it would not be sensible for me to attempt to lay down a hard and fast order of priorities or

to attempt to assign a timetable for the work that is required. At one extreme there will be risers that are known to have been *in situ* for a matter of decades. At the other, there will be risers that are known to have been installed in recent years. In recent installation, wherever it can be said that the integrity of the risers is satisfactory for the time being, and that it can be treated as a low priority case, it will be reasonable to defer replacement and to institute a managed inspection scheme in the meantime. What matters is that the programme of riser replacement, whatever its phasing, must be treated as an integral part of the overall replacement programme and pursued with a sense of urgency. As work on the replacement programme progresses, further knowledge will be gained. It is likely therefore that the assessment of priorities, overall and on individual sites, will be reviewed and amended. I therefore recommend that HSE, in consultation with UKLPG, should set the order of priorities and keep it under review as experience of the work grows.

An urgent review of safety of buildings Inspection

One of the causes of this disaster was that when the alterations were made to the basement and to the yard, the safety considerations that those alterations raised were overlooked. There may be many premises with LPG installations that were not built to current standards where the design itself or some subsequent alteration may have created LPG hazards. I therefore recommend that, in conjunction with the survey of the underground pipework, the premises themselves should be inspected in order to identify any conditions that create the risk that leaking LPG may migrate and accumulate in unventilated spaces.

Modification of existing installations

In relation to existing buildings, the key considerations are whether the pipe entry is above or below ground, whether pipe entries below ground are sealed and whether the pipework is routed through unventilated spaces.

Unventilated voids - interim measures

The existing LPGA guidance (CoP 22:2002, s 2.2.6), which proscribes the installation of pipework in unventilated voids, does not apply to existing installations. This points to the need for a systematic programme of inspection of all buildings that have an existing supply.

If LPG pipework in such buildings is found to be passing through an unventilated void, the priority should be to have it re-routed. Where that is not possible within a reasonable time and at reasonable cost, and only in that case, the pipework should be sleeved continuously through the void with a sleeve ventilated to a safe place. This is the recommendation of IGEM in relation to new installations where pipework is to be run through an unventilated void (cf IGEM/UP/2, 2008, ss 7.22.3 and 10.4). My own view, in the light of this disaster, is that in all new installations such pipework should be forbidden.

Putting pipework entries above ground

The vulnerability of an underground pipe entry point to the migration of leaked LPG from buried pipework was a major and ultimately disastrous weakness in the installation at Grovepark Mills. The recommendations of the current LPGA Code of Practice relate primarily to new installations but are intended to apply also to modifications and alterations to existing installations (LPGA CoP 22:2002, s 1.2). The current IGEM guidance on the point applies to new installations only, but is subject to the

recommendation that existing installations should be modified to meet the new standard (IGEM / UP/2, 2008, s 1.4).

The existing LPGA guidance (CoP 22:2000, s 2.1.3) rather cautiously recommends that "wherever possible" service pipe entries to buildings should be above ground and that an ECV should be installed as near as is reasonably practicable to the point of entry. For industrial and commercial buildings the Code of Practice refers to IGEM/UP/2, which, while advising that it is preferable to use above-ground entries, recommends that if pipework has to enter or exit from below floor level it should do so through a continuous gas-tight sleeve (*ibid*, s 9.2-9.3).

In the light of this Inquiry I consider that these recommendations do not go far enough. In my opinion, it is only in the most exceptional cases that such arrangements should even be contemplated. The normal rule should be that all existing installations should be modified, if necessary, to bring the pipework into the building above ground level and with an ECV fitted near to the entry point. The advantages of that are obvious, particularly in an improved safety regime based in part on routine inspections.

Sealing pipe entry points

The amateurish way in which the pipework was led into the building at Grovepark Mills through a hole knocked in the brickwork and without any attempt to seal the gap was a major defect in the original installation. It is essential that at the entry point through an external wall LPG pipework should be sleeved and that the sleeve should in turn be sealed to the structure. This arrangement should ensure that gas cannot pass between the pipe and the sleeve or

between the sleeved pipe and the wall, but should allow normal movement of the pipe. These requirements are to be found in both the LPG Code of Practice (s 2.2.6) and the IGEM guidance (s 7.3.2). In my view, they should be mandatory in all existing installations.

If the pipe entry is below ground, it should be re-routed above ground and fitted with an ECV. Likewise, pipework passing through unventilated spaces should be re-routed or appropriate ventilation should be installed.

These requirements will cause expense and inconvenience to users; but it was considerations of expense and inconvenience that underlay the misguided approach of the late Mr Stott. In my view it is only if it can be shown that the remedial measures that I propose are impossible that any other option should be considered. In that event, a safety case should be prepared and should be subject to verification by an approved competent person (ACP) in accordance with my later recommendations, the test being whether any other solution can be shown to achieve an equivalent level of safety.

PHASE 2 – CREATING A NEW SAFETY REGIME

Introduction

The immediate priorities that I have identified are only an aspect of the wider question of putting LPG safety on a new footing. That question involves the creation of a system directed to ensuring life-cycle integrity of every LPG installation.

In the following part of this chapter I shall discuss a proposed new safety regime from

the standpoints of the user, the supplier and the regulatory authorities. These are the foundations on which a new and long-term safety regime should be built. Thereafter I shall put forward the principles on which a permanent and more methodical system of communication between all parties affected by LPG safety should be devised.

The user's role in safety

The responsibility of the user

All of the many questions surrounding a proposed safety regime were considered at the Inquiry largely in the context of the responsibilities of HSE and of the suppliers. That represents a seriously incomplete view of the problem.

For the purposes of this report, I am not concerned to explore the legal principles regulating the civil liabilities of the owner, the occupier and the user. I proceed on the basis that the user has a legal interest in the site, whether as owner or as tenant, or has some lesser entitlement to occupation of the site, perhaps by way of a licence from an associated company in a group. On that basis, it is sufficient to say that, whatever the scope and extent of the civil liabilities of all the parties having legal interests in the site, the primary responsibility for the safety of the LPG pipework should rest with the user of the installation. It is he who brings a hazardous substance onto the site. It is he who has the means at hand to inspect and maintain the pipework. The user cannot, in my view, rely on the oversight of HSE or on the expertise of the supplier to absolve him of that responsibility.

I make this seemingly obvious point because the evidence shows that, until a late stage in the

history, the ICL companies at Grovepark Mills neglected properly to consider the hazards that were associated with the LPG installation, or were content not to give safety an appropriate degree of priority, so long as they were under no pressure on that subject from HSE or from their suppliers.

I think that it should be made clear to all users of LPG that inspection of LPG sites by HSE, cannot relieve them of their own direct responsibilities for the safety of their installations.

The Installation Record

The "interface" problem

There may be a multiplicity of legal interests involved in any LPG installation. In the normal case ownership of the installation is divided between user and supplier; but the position is less straightforward where the user's interest in the site is less than that of ownership or where there is a metered supply to multiple users controlled by a landlord or a supply of a similar kind that is managed on behalf of multiple users. In my view, it should be an elementary principle that the number of "interfaces" between responsible parties should be minimised in the interests of safety. Good practice requires that all parties should know the extent of their ownership or other legal interest in the installation and the nature and extent of their legal rights and duties; and that these matters should be set out in a readily accessible source, an "Installation Record," by means of diagrams, plans and appropriate documentation.

These principles have added point where there is a handover from one supplier to another or where contractors are engaged to carry out any work on the installation itself or any work

that may affect its integrity. The present HSE leaflet *Checking LPG Pipework – Industrial and Commercial User Responsibilities* (C70, March 2006) is a timely contribution to the task of educating users to understand the extent of their responsibilities. I consider that my proposal for the institution of Installation Records would be an essential step in this process.

The functions of an Installation Record

One of the reasons why this tragedy occurred was that the pipe was out of sight and out of mind. Johnston Oils, who happened to be the last supplier to the site, carried out the tank exchange in a thoroughly professional way; but then linked the tank installation to a system of pipework about which they knew little or nothing. They saw that part of the installation as being the customer's responsibility.

Since there was no readily available record of the history of the installation, one can understand why the underground pipework was not seen as a matter for concern by either Calor or Johnston Oils, and was completely missed in the ICL risk assessments.

I therefore regard it as essential that every LPG installation should have its own comprehensive Installation Record. The Installation Record would provide safety features that were wholly lacking in this case. It would be a clear and complete source of data regarding the installation and its history to which all interested parties could refer. It would provide for a process of continuous assessment of the safety of any individual installation. Its existence would raise awareness of safety considerations on the part of users and suppliers. In short, it would help to promote a suitable safety culture. It would also be a compendious source book

demonstrating that the installation complied with all relevant statutory requirements and provide for a better appreciation of safety questions as they arose. In this way, it would assist HSE in its inspection and enforcement functions.

Contents of the Installation Record

The contents of the Record should include, in my view, the following:

- (a) a concise account of the history of the installation from its introduction to the site setting out all modifications and adaptations to it, and all tank exchanges;
- (b) detailed drawings of the installation from tank to appliance, with a full technical specification including a note of all working pressures, materials used and the like;
- (c) details of the safe operating envelope for the LPG system;
- (d) a summary of the engineering safeguards designed to prevent safety incidents;
- (e) a complete record of all inspections and reports of inspections;
- (f) a complete record of all maintenance carried out to any part of the system;
- (g) a set of layout drawings of those parts of the site in which the installation was situated;
- (h) a set of drawings of those parts of the building from the entry point to the LPG appliance and of those parts adjacent to the installation that could have safety implications for the installation itself or could be affected by an incident involving the installation;
- (i) a concise statement of the legal responsibilities of the various interests on site under the Health and Safety at Work Act and subordinate regulations;
- (j) a concise identification of the parties having legal interests in the site; that is

to say, the owners of the site or of parts of it; the occupiers of the site or parts of it, whether under lease or licence; and the customer who is contracted with the supplier, if that customer is neither an owner nor occupier;

- (k) a statement of the legal responsibilities of those parties having an interest in the installation itself, namely the user and the supplier;
- (l) a notice identifying the enforcing authority for safety on the site;
- (m) a risk assessment covering the design and operation of the installation complying with MHSVR and DSEAR;
- (n) instructions for a response to any emergency that may arise; and
- (o) a current and valid verification certificate in accordance with one of my later recommendations.

I further recommend that guidance on the detailed contents of an Installation Record and a suitable template should be developed by HSE in consultation with UKLPG. HSE and UKLPG could prepare a suitable statement of recommended practice regarding ownership, demarcation of responsibility and consequent legal duties.

Responsibility for keeping the Installation Record

I recommend that the preparation, maintenance and safe custody of the Installation Record should be the direct responsibility of the user. One of the core participants, Mrs Ferguson, suggested that if there were to be such a Record, there should in every case be a named person having responsibility for custody of it. That, in my view, is a sound proposal and I adopt it.

A verification scheme

Existing guidance

The LPGA CoP No 1, Part 3:2006 and the Technical Memorandum (TM) No 84 deal with the vital question of effective inspection of LPG pipework. TM No 84 recommends that employers, by which is meant, I assume, the user or, during tank filling, inspection or maintenance, the supplier, should have a strategy for the periodic inspection and testing of all pipework and that the findings of the inspection should be reviewed by a competent person who should make suitable recommendations for any changes to the strategy that may be necessary (sections 2 and 5).

The HSE Leaflet “*Checking LPG Pipework*” (ref 16) is to similar effect. It recommends that the party responsible for the pipework should ensure that a competent person draws up an inspection and maintenance strategy if one does not exist. Where metallic pipework is buried, HSE’s guidance to its inspectors suggests as an appropriate level of competency that of the Institute of Corrosion, Pipelines Coating Inspector, Level 2.

The outline of a formal verification scheme

It is not enough that an Installation Record should indicate the condition of the installation. It is essential, in my view, that there should be independent scrutiny of every installation by a competent third party at regular intervals throughout its life. The existing guidance to which I have referred should in my view be developed into a formal verification scheme by means of which the integrity of every LPG installation would be periodically assessed by an approved competent person (ACP). A verification scheme would, I think, have averted this disaster.

I propose therefore that every installation should be subject to mandatory periodic verification by an ACP whose duty it would be to verify the integrity of the installation and to certify whether or not the installation itself, the safety regime applying on site and any mitigation measures in place at the site were satisfactory. The presence of plans within the Installation Record would alert such an ACP to possible hazards created by the design of the building.

Under such a scheme a verification certificate could be granted or refused outright; or it could be withheld pending the completion of any remedial work that the ACP might require. The granting of a certificate would be a condition precedent to the continued use of the installation.

The details of such a scheme, and the intervals at which verification would be necessary, should be a matter for discussion between HSE and UKLPG.

The choice of an ACP

If such a scheme were to be introduced, an important question of policy would arise as to the choice of an ACP. It was suggested at the Inquiry that there might be good reason why the LPG supplier could act as the ACP if it were to be suitably accredited. I do not accept that suggestion. It is important that scrutiny of this kind should be independent both in substance and in appearance.

The response of the industry and HSE

I have taken account of the concerns of Calor and UKLPG on this aspect of the case. Calor’s position is, in brief, that verification is unnecessary if there is an installation record in existence and if GSIUR is extended to

industrial premises. UKLPG makes the point that considerable time and effort would be involved in the monitoring of a formal competency scheme and that such a scheme would add to existing skills shortages. More fundamentally, UKLPG suggest that a verification scheme would externalise the accountability and the responsibilities that ought to remain with the duty holder. On balance, UKLPG considers that the available resources would best be directed to the pipework replacement programme, the introduction of the installation record and the extension of GSIUR to industrial premises.

HSE has no objection to a verification scheme, provided that it does not divert resources from a prioritised pipework replacement programme.

Notwithstanding the views of Calor and UKLPG, I consider that a verification scheme would have a useful and distinctive part to play in a new safety regime. It would be a means of enforced periodic scrutiny and a valuable way of promoting a safety culture.

There was general agreement that if a verification scheme is to be introduced, it should be developed jointly by UKLPG and HSE. I support the view of HSE that in that event HSE should take the lead role. That, I think, would correctly reflect HSE's statutory role and would be particularly appropriate if the accreditation element in the scheme were to involve CAPITA, the successor of CORGI.

Sanctions

Under a verification scheme of this kind it would be appropriate that wherever a verification certificate was not in force, it should be unlawful for the user to use the installation or to obtain any further supply of LPG to it.

Mr Sylvester-Evans invited the Inquiry to consider whether such use or the obtaining of a supply in such circumstances should be a criminal offence.

It seems to me that there is little point in a verification scheme if there is no effective sanction against the LPG user who continues to use an installation for which a valid verification certificate is not in force.

Having regard to the risks involved in the use of a system that is *ex hypothesi* unsafe, I do not regard the imposition of a criminal sanction on the user in such a case as being disproportionate. On the contrary, it would be a powerful incentive to safety.

The role and responsibilities of the supplier ***The tank***

Notwithstanding the primary responsibility of the user, the practice of the industry is, in most cases, that the supplier retains ownership of and responsibility for the tank. Although the merits of that practice have not been debated at the Inquiry, no party has suggested that the practice should change. The practice seems to me to be conducive to safety. It ensures a safe and efficient standard of installation, a systematic and effective system of monitoring and inspection, and the safe and competent reconditioning of tanks at tank handovers or at other appropriate intervals. In view of the potential for an explosion or a BLEVE if the tank contents were to leak and ignite, and in view of the paramount importance of maintaining the integrity of the tank, it is desirable that in such cases the supplier should accept responsibility for the tank and for some part of the tank pipework up to a defined stage.

The responsibility of the supplier for the installation should be regulated contractually in every case; but, for reasons that I shall discuss, I am opposed to any idea that the supplier should be made responsible for pipework beyond that defined stage.

While it is in the interests of safety that the supplier should accept responsibility for the tank, I can see no reason why the supplier should have to accept any responsibility for the system into which he supplies his product and I can see cogent reasons why he should not. The supplier may have no first-hand knowledge of the history of the installation on the site; he has no control over the site and no right of access to it and may not be in a position to carry out inspections at a frequency and to an extent that the proper exercise of such a responsibility would require. If the supplier were to have such a responsibility, he might be open to claims by the customer if, for example, his inspection or maintenance of the installation were to disrupt production. There would also be serious insurance implications.

In my view, there is every reason why legislative and regulatory policy should rest on the simple proposition that any such installation should at all times be the overall responsibility of the person who uses it.

Where should the supplier's responsibility end?

One extreme option is that the supplier should accept responsibility, if not even outright ownership, of the service pipework up to and including the Emergency Control Valve (ECV). This option has the superficial attraction that it would align the position in LPG installations with the well-recognised arrangement in the supply of natural gas. It also has the attraction that the

LPG supplier would, in general, be thought to be more competent in ensuring the integrity and safety of the pipework. It would also provide a clear line of demarcation.

Despite these seeming advantages, I reject this option. In my opinion, it would be wrong in principle that the owner or occupier of the site should be relieved of the direct responsibility that flows from the use of pipework that is *pars soli*; or that the supplier should have to accept responsibility for pipework to which he has no right of access, and which he has no right to alter, adapt or excavate without the permission of the user and the owner or occupier of the site, if that should be a different person.

There would also be, in my view, a material risk that where the supplier prescribed changes to the service pipework in the interests of safety, the user might switch suppliers rather than incur the expense that such changes might entail.

On the whole matter I am convinced that the supplier's responsibility should be restricted to that of responsibility for the tank and for the pipework associated with the tank itself. That reflects the *status quo* in almost every case. It focuses the attention of the supplier onto the tank and filling area. It avoids complications at tank exchanges. It gives the supplier responsibility for equipment over which he can contractually retain ownership and exercise a contractual right of access.

This option, however, has the consequence that a greater burden of responsibility is devolved upon the user, or owner or occupier of the land, and with it a responsibility to adopt more rigorous safety practices than were to be seen at Grovepark Mills.

The question then is at what point the responsibility of the supplier should end. The Inquiry has shown that in practice there are only two options; namely that the responsibility of the supplier should extend only to the Vapour Off Take Valve (VOTV) or that it should extend to the First Stage Regulator (FSR).

Both arrangements are to be found in current practice. That fact alone is a cause for concern, particularly when there is a change of supplier and a consequent change in the contractual arrangements on that question.

The first option is insisted on by Calor in its conditions of contract. Since the vapour off-take valve is invariably part of the tank assemblage, this option has the attraction that it is clear-cut and incapable of ambiguity or misinterpretation.

The second option is adopted by Johnston Oils and is the predominant practice in the industry. It has the disadvantage that in many installations the first-stage regulator is sited some distance from the tank, which increases the extent of the supplier's responsibility.

Whichever option is to be preferred, it is vital, in my opinion, that only one option should be permitted and that that option should be enforced rigorously throughout the industry. Where there is a change of supplier and the new supplier's contract conditions on this point differ from those of his predecessor, the scope for misunderstanding creates a serious safety hazard.

My own view is that the uniform rule throughout the industry should be that the supplier's liability extends up to the first-stage regulator. Despite the simplicity and clarity of the Calor approach, I think that it is best to adopt the solution that

reflects the prevailing practice in the industry. I also favour this solution because in cases where the first-stage regulator is at a distance from the tank, it is undesirable that the customer, or the person in control or ownership of the site, should be responsible for the intervening length of pipe which at that point is carrying LPG at tank pressure.

Enforcing the uniform demarcation of responsibility

The next question is how best to secure a uniform extent of responsibility. My recommendation is that a provision specifying that the supplier is responsible up to the first-stage regulator should be mandatory in every supply contract. I also recommend that the demarcation of responsibility should be spelled out in clear terms in the Installation Record. Finally, I recommend that, to fortify the statement of responsibility, the pipework on either side of the first-stage regulator should be colour coded for the avoidance of doubt.

Making risk assessments effective

The user, as employer, is obliged by DSEAR to make a suitable and sufficient assessment of the risks to his employees which arise from dangerous substances at the workplace. Among these are the risks of fire and explosion. The same obligation rests on the supplier when his employees are at the site, for example during tank filling.

The assessment must also cover the scale of the likely effects of a fire or an explosion. This therefore requires the user to assess the likely effects of an explosion on the structure of buildings. The risk assessment must be site specific. Generic assessments can be a useful starting point but it is essential to consider site

specific risks. The user and the supplier are obliged under DSEAR (reg 11) to co-ordinate the risk assessments of their respective equipment. This obligation represents an important means of communication between supplier and user and is conducive to the making of an effective risk assessment overall. Both the user and the supplier, as employers, have a duty (DSEAR, reg 5(3)) to review and up-date the risk assessment periodically, or at the time of a significant change to the installation, such as a tank exchange.

This case has demonstrated the weakness of the risk assessment process. The regulations merely oblige the employer to carry out an assessment. They do not provide any safeguard that will ensure that the assessment is properly carried out by a competent person; or that it is subject to any form of independent expert audit. I do not doubt that the risk assessments at Grovepark Mills were carried out conscientiously, but this case demonstrates that formal compliance with MHSVR and DSEAR gives no assurance of safety.

This is a public inquiry and not a law reform project. I do not feel that it is appropriate that from the evidence of one case I should extrapolate any general principles for the amendment of the existing regulations. However, I recommend that the Ministers should consider whether the existing regulations on risk assessment could be made more effective, perhaps by the addition of some form of independent safety audit.

The industry

A registration scheme

In view of the hazardous nature of LPG, the risks involved in the transportation and delivery of it and the responsibilities of suppliers in relation

to LPG installations, I think that it is entirely reasonable that all suppliers of bulk LPG in the United Kingdom should be accredited and publicly identified. At present, entry to the retail LPG market is open to anyone who can source a wholesale supply of the product. Competition policy may point to the wisdom of that; but from the point of view of public safety, it cannot be a wise policy to allow unrestricted entry to an industry in which the consequences of a failure in safety can be so catastrophic.

In my opinion, the importance of the safety considerations necessitates that there should be a registration scheme for all bulk suppliers of LPG; that registration should be in the form of accreditation based on the achievement of certain minimum standards and that registration should be a condition precedent to the supply of LPG to any user on any terms.

I should make clear that in making this proposal I do not envisage the establishment of a formal licensing scheme.

Calor and Johnston Oils support this proposal; but opinion within UKLPG is divided. Mr Shuttleworth of UKLPG expressed concern that a registration scheme, if introduced, should not be unduly onerous on the supplier and should not act as a deterrent to the entry of new suppliers in the market. In my view, neither objection is cogent.

In my view, a registration scheme is a necessary element in the safety strategy that I propose. It will enable HSE to set what it considers to be appropriate standards for entry to the market. It would be for HSE in consultation with UKLPG to decide what the standards for accreditation should be.

A uniform contractual provision as to the extent of the supplier's responsibility for service pipework

I have already given my reasons for concluding that the responsibility of the supplier should end at the first stage regulator. To ensure that that position is applied uniformly throughout the industry, every supplier should be obliged to include a provision to that effect in its terms and conditions.

Supply to unverified installations

I also propose that unless a verification certificate is in force for the installation, it should be unlawful to supply LPG to it.

I have already commented on the idea of there being criminal liability for the unlawful use of an installation for which there is no verification certificate in force. It would seem logical that there should be a complementary liability on the part of the supplier who supplies to such an installation.

UKLPG was resistant to the idea that there should be a criminal liability on the part of the supplier in such a case. It regarded that idea as being inconsistent with the principle that the fundamental responsibility for the safety of the installation from the service pipework downstream should rest with the user. UKLPG also figures the case where a supplier doubted the safety of the system but the user nevertheless had a valid certificate. It considered that the other proposed recommendations that I have now accepted would provide a regime where the respective responsibilities of user and supplier were clearly defined and that it was the responsibility of HSE to ensure compliance with the regime. UKLPG considered that a criminal sanction on the supplier in such circumstances would be disproportionate.

I do not regard the idea of a criminal sanction against the supplier as being disproportionate. Where the obligation would be on the user to obtain a valid verification certificate, the supplier would have only the lenient obligation of requiring the user to produce the certificate before the supplier made the supply. Not to do so would, in my view, be irresponsible. The sanction in this case would be a considerable deterrent to the rogue supplier in such circumstances. In the case figured by UKLPG, the production of a valid certificate would absolve the supplier of any criminal liability; but if the supplier nevertheless doubted the safety of the system, it would remain the duty of the supplier to withhold the supply.

The supplier's own record

I also recommend that, in addition to the Installation Record that should be maintained on site, each LPG supplier should be required to maintain a formal record relating to each site to which it supplies LPG. This record should include the supplier's current asset register, specifying the individual items of equipment of which the supplier contractually retains ownership; incorporating the provisions of the Installation Record as to the respective responsibilities of the supplier and the user; and noting the critical safety features, inspections records and risk assessments for all such equipment. The supplier should be under an obligation to furnish a copy of the relevant section to each user.

PHASE 3 – THE CONTINUING DEVELOPMENT OF THE SAFETY REGIME

A continuing programme of monitoring of buried polyethylene pipework

Phase 1 of my proposed action plan has the purpose of having all buried metallic vapour

phase pipework replaced by polyethylene pipework at the earliest practicable date. That of course will lead into a further safety question affecting the polyethylene pipework. It too is subject to long-term decay and, to a greater extent than metallic pipework, to impact damage. The safe life of a polyethylene pipe is thought to be about 50 years; but since such pipework has been in use only since the early 1980s that remains to be proved. It is essential therefore that the mistakes of the past are not repeated in relation to buried polyethylene pipework. There therefore has to be a programme of continuing research into the safety of polyethylene pipework and a compulsory requirement on users systematically to check the integrity of such pipework within their sites.

Should the UKLPG Codes of Practice be approved?

Thanks to the efforts of UKLPG and its predecessor, the industry is guided by Codes of Practice that are familiar to HSE and of which it has no criticism. In stage 2 of the Inquiry, the question was raised whether the status of these Codes should be elevated to that of Approved Codes. Some participants considered that that would ensure a better standard of compliance with the Codes by suppliers and users alike.

I do not regard this as being an issue of any great significance. In my view, it is the substance rather than the form of the Codes that matters. If UKLPG and HSE were to agree that there was a useful purpose to be served by the elevation of the status of these Codes, it would be open to HSE to do so. That is a matter that can be left to those bodies to decide. I make no recommendation on the point.

PHASE 4 – ESTABLISHING EFFECTIVE COMMUNICATIONS AND CLARIFYING RESPONSIBILITIES

Improved communication

Communication of knowledge

I see it as essential that there should be prompt and effective communication between all interested parties of all technical developments in matters of LPG safety, and of all LPG incidents and the lessons to be learned from them. Such communication would have ensured that the Daventry incident, to which I have referred, and the lessons to be learned from it, would have been publicised throughout the industry promptly and effectively. On that occasion, the occurrence of the incident was not even properly communicated within HSE itself. A suitable communication system should be established by HSE in consultation with UKLPG.

Communication within HSE

On the evidence before the Inquiry, I think that HSE has learned the necessary lessons from its own previous failures to communicate knowledge effectively within its own organisation.

Communication of advice

The record of UKLPG in the promotion of good practice is impressive. I recommend that HSE should, in consultation with UKLPG, prepare practical advice for LPG users regarding the fulfilment of their statutory duties, particularly under DSEAR. We may be confident that UKLPG will continue to give such advice to its members and to make such advice available to suppliers who are not members of UKLPG.

Communication between HSE and UKLPG

I have no reason to think that the relations between HSE and UKLPG are in any way unsatisfactory. But it is important, I think, that in matters of safety there should be the fullest possible sharing of knowledge between these bodies based on a relationship of trust and mutual confidence. The ideal is that there should be complete sharing of knowledge relating to LPG incidents. HSE has access to knowledge of such incidents arising from the data collected on dangerous occurrences under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR) and from its own inspections of LPG sites; but UKLPG may also have knowledge from its members of incidents and potential incidents not reportable under RIDDOR from which there are lessons to be learned. It would be regrettable if such knowledge were not to be shared through fear of the consequences, through an unwillingness to admit fault or through a mistaken concern for commercial sensitivity.

Communication from supplier to user

There is general agreement that the supplier in every case should assist the user with practical guidance on LPG safety matters of which the user, and particularly the small user and the new user, may be unaware; and that the supplier should be obliged to provide the user with details of its asset register, critical safety features, examinations, inspections and risk assessments for its equipment on the user's site.

A users' forum

There was a division of opinion at the Inquiry as to the value of establishing a users' forum under the auspices of HSE and/or UKLPG. Such a forum could provide a means for the sharing of knowledge and ideas in the field of LPG

safety. While I accept that such a forum would contribute to effective communication, I am not persuaded that there is any urgent need for it. I think that the better course is to implement those recommendations that are urgent, to put in place the introduction of Installation Records, verification, accreditation and so on and in the light of the modern updated regime that will then exist, to leave the desirability of such a forum to be considered in the new context of LPG safety.

A safety regime for the regulatory authorities Responsibilities for inspection and enforcement

I have commented on the lack of clarity as to the responsibilities of HSE and local authorities in the enforcement of safety of buildings. In my opinion, it is essential that the respective roles and responsibilities of these bodies in relation to LPG risks should be clearly identified in every case and should be set out expressly in the Installation Record.

It is my hope that if Installation Records were to be introduced, any proposed change in the layout or construction of a building to which LPG was supplied or was to be introduced would be carefully considered for its safety implications.

While it is obvious that there should be a clear definition of responsibility for regulatory oversight for each commercial and industrial LPG site, it is also clear that there should be a clearly defined responsibility for reviewing the safety of the building into which the supply is made.

What the responsibilities of HSE and the local authorities should be, and whether it is desirable that there should be two regulatory bodies in this field, are wider issues. Since the local authority did not take part in the Inquiry and since a major investigation into

the desirability of there being two regulatory authorities in relation to the structural safety of buildings into which LPG is supplied would stray beyond my precise terms of reference, I do not consider that it would be appropriate for me to make any recommendations on that subject, even if I were in a position to do so. It is sufficient for the purposes of my own terms of reference that I should comment that there seems to be an area of uncertainty that should be clarified in early course.

In the meantime it is important that HSE should publish more detailed guidance on the assessment of the structural safety of buildings into which LPG is supplied.

Appendices

Appendix 1 – List of core participants

Calor Gas Limited

Health and Safety Executive

ICL Plastics Limited

Johnston Oils Limited

Members of bereaved families and injured survivors as represented by Thompsons Solicitors

Mrs Anne Fergusson

Mrs Sheena O'Brien

Mrs Joyce Russell

Mrs Louise Smith

Appendix 2 – List of witnesses before the Inquiry

Stage 1

Gordon Bell	2 July 2008	Read out	ICL employee on site at the time of the disaster
David Andrews	2 July 2008	Read out	ICL employee on site at the time of the disaster
James McGoldrick	2 July 2008	Read out	ICL employee on site at the time of the disaster
James Baxter	2 July 2008	Read out	ICL employee on site at the time of the disaster
Ian Mavers	2 July 2008	Read out	ICL employee on site at the time of the disaster
James Smith	2 July 2008	Read out	ICL employee not on site at the time of the disaster
Andrew Galloway	2 July 2008	Read out	Non-ICL employee on site at the time of the disaster
Lynn Cameron	2 July 2008	Read out	Eye witness to the explosion
Jacqueline Brown	2 July 2008	Read out	Eye witness to the explosion
Anne Marie Donnelly	2 July 2008	Read out	Eye witness to the explosion
George Leyden	2 July 2008	Read out	Eye witness to the explosion
James Moir	2 July 2008	Read out	Eye witness to the explosion
William McDonagh	2 July 2008	Called	Rescue and arrangements for investigation
James Porteous	2 July 2008	Called	Rescue and arrangements for investigation
William Brodie	3 July 2008	Read out	Employee of Calor Gas
Keith Young	3 July 2008	Called	Employee of Calor Gas
Maurice Coville	3 July 2008	Called	Employee of Calor Gas
Alexander Clezy	3 July 2008	Read out	Employee of Calor Gas
Henry Betts	3 July 2008	Called	Employee of Calor Gas
William Delaney	4 July 2008	Called	Employee of Calor Gas
Kenneth Platt	4 July 2008	Read out	Employee of Calor Gas
Thomas Dudgeon	4 July 2008	Called	Employee of Johnston Oils Ltd (J Gas)
Alan Elliot	4 July 2008	Called	Employee of Johnston Oils Ltd (J Gas)
David Inglis	8 July 2008	Called	Employee of Johnston Oils Ltd (J Gas)
Sue Johnston	8 July 2008	Called	Evidence relating to HSE visits
Alistair Gunn	8 July 2008	Called	Evidence relating to HSE visits
Alexander Keddie	8 July 2008	Called	Evidence relating to HSE visits
John Ives	9 July 2008	Called	Evidence relating to HSE visits
Alan Tyldesley	9 July 2008	Called	Evidence relating to HSE visits
Alan Tyldesley	10 July 2008	Called	Evidence relating to HSE visits
Alistair McNab	10 July 2008	Called	Evidence relating to HSE visits

Stage 1 continued

Alistair McNab	11 July 2008	Called	Evidence relating to HSE visits
John Powell	11 July 2008	Called	Evidence relating to HSE visits
Cameron Adam	11 July 2008	Taken as read	Evidence relating to HSE visits
Annette Leppla	11 July 2008	Taken as read	Evidence relating to HSE visits
Michelle Gillies	11 July 2008	Taken as read	Evidence relating to HSE visits
Michael Wilcock	11 July 2008	Taken as read	Evidence relating to HSE visits
Donald Sloan	11 July 2008	Taken as read	Evidence relating to HSE visits
Bryan Cousland	11 July 2008	Called	Evidence relating to HSE visits
Ian Bowie	11 July 2008	Called	Evidence relating to HSE visits
Alastair McCourt	15 July 2008	Called	Non- ICL person (Safety Consultant)
James Kincaid	15 July 2008	Read out	Non- ICL person (Gas Engineer)
Paul McClintock	15 July 2008	Called	Non- ICL person (Fire Officer)
Steven Smith	15 July 2008	Taken as read	Non- ICL person (Fire Officer)
Stuart Murie	15 July 2008	Called	Non- ICL person (Group Manager Building Control and Support Services)
John Turner	15 July 2008	Read out	ICL Director/employee
Sheena O'Brien	15 July 2008	Read out	ICL employee
Nicholas Downie	15 July 2008	Called	ICL Director/employee
William Masterton	15 July 2008	Read out	ICL employee
Tracey Downie	16 July 2008	Read out	ICL employee
Campbell Downie	16 July 2008	Called	ICL Director/employee
Campbell Downie	17 July 2008	Called	ICL Director/employee
Lorna Downie	17 July 2008	Called	ICL Director/employee
Colin Foard	17 July 2008	Called	ICL Director/employee
Peter Marshall	17 July 2008	Called	ICL Director/employee
Lynda McColl	17 July 2008	Called	ICL employee
George McLean	17 July 2008	Taken as read	Investigation and explanation of the cause of the disaster
Jean McGoldrick	17 July 2008	Taken as read	Investigation and explanation of the cause of the disaster
Andrew Stott	22 July 2008	Called	ICL employee
Francis Mellor	22 July 2008	Taken as read	Investigation and explanation of the cause of the disaster
Stuart Hawksworth	22 July 2008	Called	Investigation and explanation of the cause of the disaster

Stage 2

Stephen Brown	21 October 2008	Called	Technical Adviser, OFGEM
Gary Tomlin	22 October 2008	Called	Senior Consultant, Advantica, formerly Technical Support Manager, Calor Gas Ltd
Henry Betts	23 October 2008	Called	General Manager, Autogas Ltd, formerly Central Operations Manager, Calor Gas Ltd
Terrence Ritter	23 October 2008	Taken as read	Calor lead contact with HSE and Calor representative on the UKLPG Board
Allan Elliot	24 October 2008	Called	Director, Johnston Oils Ltd
Rob Shuttleworth	24 October 2008	Called	Chief Executive, UKLPG
Jeffrey Watson	24 October 2008	Taken as read	Technical Manager, UKLPG
Brian Neale	24 October 2008	Called	Independent consultant (chartered engineer), formerly Principal Specialist Inspector, HSE
Roger King	4 November 2008	Called	Expert in chemical engineering and corrosion science
Henry Betts	4 November 2008	Called	General Manager, Autogas Ltd formerly Central Operations Manager, Calor Gas Ltd
Dr Brian Fullam	4 November 2008	Called	Head of Process Safety Topic Group, HSE
Philip Papard	5 November 2008	Taken as read	Principal Inspector of Health and Safety within the HSE Safety Unit
Alistair McNab	5 November 2008	Taken as read	Head of Operations for the Field Operations Directorate (FOD) in Scotland (HSE)
Sandra Caldwell	5 November 2008	Called	Deputy Chief Executive of HSE/Director
Geoffrey Podger	6 November 2008	Called	Chief Executive, HSE
Rod Sylvester-Evans	7 November 2008	Called	Independent Consultant

Appendix 3 – Chronology of legislation, regulations, codes of practice and guidance

(Note: Some of the early FI/HSE guidance was for internal use only and not for general distribution to LPG suppliers and users.)

DATE		NOTES
First published in 1940 (9 Revisions)	NFPA Code 58 American National Fire Protection Association Code 58	- Referred to in a number of early UK LPG related codes
December 1959	IGE Communication No 563 Recommendations for the laying of steel gas service pipes	- Aimed at mains gas - Deal with the service pipe from the gas main to the consumer's control - highlighted the hazard of corrosion to steel service pipes which was addressed by wrapping pipework - Supplements BS COP 331.101 - Wording revised in IGE/TD/4 (1973)
1959	Building (Scotland) Act	- Enabled the setting of building regulations
1961	Factories Act 1961	- Applied to certain safety, health and welfare matters in premises which fell within the definition of 'factory' - Contained provisions for the enforcements of legal requirements and imposed penalties for contraventions - Dealt with precautions required when working on pipework and installations carrying flammable materials including LPG but did not deal with their design or maintenance - No provision for maintenance or design of work equipment in general other than for guards and fencing
1961	LPGITC COP Code of Practice for Installation of bulk LPG storage at consumers' premises	- Sets minimum standards for bulk LPG installations at consumers' premises - Covers tanks, pipework and fittings up to the inlet of the first stage regulator - Does not cover corrosion protection of pipelines, periodic inspection of pipelines or routing of pipelines and point of entry to the building - Outlines minimum separation distances - All materials must be resistant to the action of LPG gases under service conditions - Reprinted yearly until 1968 (with the exception of 1965 and 1967) with a revision in 1963
1963	LPGITC COP Installation of bulk LPG storage at consumers' premises Revised Edition	- Revised in 1969
1963	NFPA American National Fire Protection Association COP Numbers 58 and 59	- Describes minimum standards of safety thought to be necessary for bulk storage of LPG
1964	Fire Protection Association (FPA) Booklet No 39 Storage and handling of Liquefied Petroleum Gases	- Identified the hazard of corrosion to pipework and risk associated with basements where escaping gas could accumulate - Reproduces the tank separation distances given in the LPGITC COP

1965	HMFI SHW 30 Safety, Health and Welfare Booklet Ministry of Labour; HMFI New Series No 30 The Bulk Storage of Liquid Petroleum Gas at Factories	<ul style="list-style-type: none"> - Identifies that the major potential hazard from storage of LPG was that of fire and explosion which could be reduced to "acceptable proportions", provided that the plant was suitably designed and adequate safety measures adopted - Gives general guidance to 'would-be' users of LP gas on the problems with storage - Made reference to NFPA Codes 58, 59, and LPGITC Code of Practice - Renamed HSW 30 in 1973
1967	IP/9 Institute of Petroleum Model Code of Safe Practice part 9: Liquid Petroleum gas Also published as the IGE/SR/6	<ul style="list-style-type: none"> - Provides a general guide to safe storage, handling and transport of LPG - Required that the location of all pipes and valves be known, and that those responsible for the operation and handling of LPG should be aware of the guidance - It also requires that piping should be protected against physical damage and corrosion - Includes training - Reiterated much of the LPGITC guidance 1969 - Superseded by IP9 Volume 1 (1987)
1967	FIC 286/1 – Fire and explosion disaster hazards	<ul style="list-style-type: none"> - The note draws attention to a wide range of major fire and explosion hazards from dusts, chemicals, gasses, highly flammable liquids and LPG - The note describes two factors which may increase the disaster potential: the process maybe housed in an unsuitable building and the scale of the plant maybe larger than customary in the part
May 1968	FIC 286/7 – Notification of fire and explosion disaster hazards to the Chemical Branch	<ul style="list-style-type: none"> - Reported back on a series of sample inspections
July 1968	IGE/SR/6 Booklet Institute of Gas Engineers Safety Recommendations Also published as IP/9 in 1967 (see above)	<p>Required that:</p> <ul style="list-style-type: none"> - location of pipes and valves be known - those responsible for the operation and handling of LPG should be aware of the guidance - Piping should be protected against physical damage and corrosion - Reiterated much of the LPGITC guidance 1969
December 1968	FIC 286/8 – Fire and explosion hazards: Causes of outstanding risk	Instructions to district inspectors regarding reporting outstanding risks to Chemical Branch
1969	DATE OF INSTALLATION OF LPG PIPEWORK & TANK AT ICL PLASTICS	
1969	LPGITC 8 Code of Practice Maintenance of Fixed Bulk LPG vessels at Consumers' Premises	<ul style="list-style-type: none"> - Includes inspection and re-test details - In 1974 is combined into COP 1
April 1969	LPGITC 1 Code of Practice: Installation and maintenance of bulk LPG storage at consumers' premises	<ul style="list-style-type: none"> - Revision of LPGITC COP 1961 - Sets standards rather than minimum standards - Discussed corrosion protection of underground vessels - Covers pipework and fittings up to the first stage regulator - Only required the pipework to be resistant to the actions of LPG - Contains minimum separation distances - Excludes inspection and re-test details for which the reader is referred to LPGITC 8 – Maintenance of Fixed Bulk LPG vessels at Consumers Premises, 1969 - Revised in November 1974
1970	Building (Scotland) Act 1970	<ul style="list-style-type: none"> - Enabled the setting of building standards
1971	Fire Precautions Act 1971	<ul style="list-style-type: none"> - Provides for the protection of persons from fire risks

1971	Home Office COP for Storage of LPG at Fixed Installations	<ul style="list-style-type: none"> - General guide to safe practice in storing and handling LPG at fixed storage installations where tanks are filled on site - Contains minimum separation distances as LPGITC COP April 1969 - 1977 Reprint - and later reissued as HSE Guidance Note CS5
1972	HFLR 1972 Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972	<ul style="list-style-type: none"> - Implemented under the FA 1961 and referred largely to highly flammable liquids but they also included commercial butane, propane and their mixtures - Regulation 7 dealt specifically with LPG - Required LPG tanks and containers to be suitably marked and where practicable stored/located in the open air - LPG had to be stored in pipe-lines and pumps or other appliances forming part of a totally enclosed pipe-line system - Repealed by DSEAR 2002
1972	Town and Country Planning (Scotland) Act	
1973	ICL PLASTICS' YARD RAISED	
1973	HSW 30 Health and Safety at Work The Storage of Liquefied Petroleum Gas at Factories Department of Employment	<ul style="list-style-type: none"> - Renamed from and same material as Safety, Health and Welfare Booklet, New Series 30 (1965) - Amended in 1975
November 1973	IGE/TD/4 Recommendations on transmission and distribution practice; IGE/TD/4 Laying of steel and ductile iron gas service pipes Communication No. 879	<ul style="list-style-type: none"> - Revision of IGE Communication No 563 - Many recommendations from IGE Communication No. 563 remained the same but some changes were made to the wording of relevant sections - Second Edition in 1981
1974	FIC 286/20 – Storage of liquefied petroleum gas at distribution depots	<ul style="list-style-type: none"> - Records the results of a series of inspections in 1973 targeted at distribution depots storing and filling LPG cylinders
1974	HSWA 1974 Health & Safety at Work Etc Act 1974	<ul style="list-style-type: none"> - Primary purpose is the securing of the health, safety and welfare of persons at work, whatever the nature of the work or of the premises on which it is carried out
1974	AEGLP TSD/2E Installation & inspection of small bulk LPG fixed storage tanks up to 5m ³ capacity	<ul style="list-style-type: none"> - Based on practices in operation in major European countries - Applicable to domestic, commercial, agricultural and industrial usages of LPG and to all tanks or groups of tanks up to 5m³ - Sets separation distances which are less than those specified in LPGITA 1
1974	LPGITA booklet Introduction to LPG	<ul style="list-style-type: none"> - Describes the essential properties of LPG, their major uses and precautions necessary for safe application - It is intended as an introduction for technical and sales staff involved in its handling or sale, for students and for users of the fuel.

November 1974	LPGITA Code of Practice 1: Installation and maintenance of bulk LPG storage at consumers' premises	<ul style="list-style-type: none"> - Revision of 1969 LPGITC 1 Code of Practice - Combines COP 8 - Buried pipelines first addressed by LPGITA - Guidance covers the distribution system up to the consuming equipment. - Sets minimum standards for the frequency of inspection and testing to be adopted - Deals with corrosion protection of underground pipework from soil conditions - Includes aspects of maintenance, inspections and testing of both pipework and vessels - Buried pipelines should be surveyed for leakage at a frequency dictated by the risks - States that all fittings not specifically covered should be checked at intervals not exceeding one year - Revised in 1978
1975	HSW 30 (Amended)	<ul style="list-style-type: none"> - Amended from 1973 version - In April 1981 is published with minor amendments as HS(G)15
1976	Fire Certificates (Special Premises) Regulations 1976	<ul style="list-style-type: none"> - Provide that a fire certificate issued by HSE shall be required in respect of premises of the kind specified in Schedule 1 to the Regulations
1977	Health and Safety (Enforcing Authority) Regulations 1977 (SI 1977/746)	<ul style="list-style-type: none"> - Made local authorities responsible for enforcement for certain activities but not for 'factories' - Revoked in 1989
1977	HSE Guidance notes for the Storage of LPG at Fixed Installations 4th Impression with amendments	<ul style="list-style-type: none"> - Reprint from COP for the Storage of LPG at fixed installations (1973)
March 1978	LPGA Code of Practice Part 1 Installation and Maintenance of Bulk LPG Storage at Consumers' Premises	<ul style="list-style-type: none"> - Revision of 1974 Code of Practice Part 1 - Revised and replaced by 4 part Code in 1991
1979	IP Model Code of Safe Practice Part 13: Pressure Piping Systems Examination 1st Edition	<ul style="list-style-type: none"> - Provides a guide to safe practices in the in-service examination and testing of piping systems in the petroleum and chemical industries, and consists primarily of scheduled examinations by Competent Persons - Second Edition published in 1993
October 1980	FIC 286/42 LPG accidents and dangerous occurrences	<ul style="list-style-type: none"> - Provided information on the number (81) and type of LPG related accidents and reported Dangerous Occurrences which occurred in the previous two years
November 1980	FIC 286/43 – Underground pipes conveying LPG	<ul style="list-style-type: none"> - Described recommendations concerning the installation, commissioning and inspection of underground pipes conveying LPG primarily in liquid form although similar standards could be applied with advantage to pipes conveying LPG vapour
1980	BS5958: Part 1 - Code of practice for control of undesirable static electricity. General considerations	<ul style="list-style-type: none"> - Metal piping should be electrically continuous so that the resistance to earth of the installation does not exceed 10⁶ ohms. - Replaced by BS 5958 (1991) - Replaced by PD CLC/TR 50404:2003 "Electrostatics: Code of Practice for the avoidance of hazards due to static electricity"
April 1981	HS(G)15 Health and Safety Series booklet The Storage of LP at Factories	<ul style="list-style-type: none"> - The object and scope remain the same as HSW30.

1981	Chemical Sheet 4 Cylinders and similar containers (HSE)	<ul style="list-style-type: none"> - Covers the keeping of cylinders and small bulk tanks - When due for review in 1997 it was decided to produce one set of guidance with input from the LP Gas Industry and HSE
1981	FIC 286/61 – Fire and explosion incidents in 1979	<ul style="list-style-type: none"> - Summarised accidents and dangerous occurrences involving the use of oil, natural gas, or LPG as a fuel in fixed installations, surface coating using flammable liquids and the operation of solvent evaporating ovens
May 1981	CS5 The Storage of LPG at Fixed Installations Guidance Note Chemical Series 5 (HSE)	<ul style="list-style-type: none"> - This was based on the HSE Guidance Notes 1977 and the earlier Home Office COP “Storage of LPG at fixed installations 1971” - Required the installation to be maintained to an acceptable standard with the objective of maintaining the safe operating limits - Develops the level of maintenance required - Reprint with minor amendments of the Home Office COP - Provides a general guide to safe practice in storing and handling LPG at fixed storage installations where tanks are filled on site
June 1981	FIM 1981/34 Underground plastic pipes for use with low pressure LPG	<ul style="list-style-type: none"> - Highlighted that plastic pipe, particularly polyethylene, is sometimes used for underground low pressure gaseous LPG and that no objection should be raised to its use at pressures below 2 bar
August 1981	Underground pipes carrying LPG, Minutes of meeting held in Chapel Street on 04.08.81	<ul style="list-style-type: none"> - New standards for HSE agreed
December 1981	IGE/TD/4 Edition 2 Gas Services Communication No. 1180	<ul style="list-style-type: none"> - Revision from 1973 - Apply to services intending to operate at pressures not exceeding 7 bar gauge - Apply to pipe diameters up to and including 50mm nominal bore for steel pipes and 63 mm outside diameter for polyethylene pipes. - 3rd Edition in 1994
1982	LPG TANK EXCHANGED BY CALOR	
February 1982	FISM 8/1982/2 Underground pipes conveying LPG	<ul style="list-style-type: none"> - Noted that the use of concrete lined trenches backfilled with sand for underground pipes conveying LPG is still being discussed within HSE and with industry
1982	AEGLP TSD/6E Installation of underground pipework for LPG vapour systems up to 4 bars working pressure	<ul style="list-style-type: none"> - The recommendations cover the minimum requirements for the selection and use of materials and components for underground LPG vapour pipework systems up to a working pressure of 4 bar
1982	AEGLP LPG installations on vessels	<ul style="list-style-type: none"> - These recommendations apply to pleasure craft, cargo ships and fishing boats
October 1982	FIC 286/68 – Small Liquefied Petroleum Gas cylinder filling plants	<ul style="list-style-type: none"> - Information to inspectors regarding small LPG cylinder filling plants
March 1983	LPGITA Technical Memorandum Part 11	<ul style="list-style-type: none"> - Recommendation for the use of polyethylene pipework for buried LPG vapour systems up to 4 bar working pressure - Covered installation, backfilling and pressure testing of polyethylene pipework but did not include advice on inspection
September 1983	FIC 286/43 Rev – Underground steel pipes conveying LPG as a liquid	<ul style="list-style-type: none"> - Replaced FIC 286/43 issued in November 1980 - Described a survey of establishments carried out by inspectors in 1982

1984	CIMAH 1984 Control of Industrial Major Hazards Regulations 1984	- Replaced by COMAH 1999
May 1985	HELA Local Authority Circular (LAC) Technical Underground steel pipes conveying LPG as a liquid	- Content is a direct reproduction of FIC 286/43 Rev
October 1986	LPGITA Code of Practice 1 Part 3 Installation and maintenance of bulk LPG storage consumers' premises – Part 3 - Periodic inspection and testing	<ul style="list-style-type: none"> - LPG supplier must ensure that LPG users are aware of the importance of carrying out a scheme of inspection - Risk based approach - A leakage survey should be carried out at least every 10 years for installations operating at 5 bar or above - States that the system should have been designed and installed in accordance with LPGITA Code of Practice Parts 1 or 2 - Revised in 2000
February 1987	IP/9 Volume 1 Institute of Petroleum	<ul style="list-style-type: none"> - Supersedes IP/9 1967 - Covers refrigerated LPG and large pressure storage at refineries, bulk distribution plants and large industrial consumer premises where such pressure storage is greater than 135m³ - States that Volume 2 IP9 was intended to cover pressure storage at industrial commercial and domestic premise but HSE has no record of this being published
1987	HSE Guidance Note CS 11 (Chemical Sheet 11) The Storage and Use of LPG at Metered Estates	- Due for review in 1997 but was decided to produce one set of guidance with input from the LP Gas Industry and HSE
1987	HSG34 The storage of LPG at fixed installations	<ul style="list-style-type: none"> - Updates and supersedes Health and Safety series booklet HSG15 and HSE Guidance Note CS5. - Required the installation to be maintained to an acceptable standard with the objective of maintaining the safety operating limits and emphasis to be placed on features affecting the integrity of the installation - In reference to underground pipework it deals only with pipes carrying liquid - Withdrawn in 2000 after being superseded by LPGA guidance (starting with LPGA COP 1 Part 1, 1998)
1988	IVES/TYLDESLEY/COVILLE 'COMPROMISE'	
May 1988	LPGITA Code of Practice 1: Design, installation and maintenance of bulk LPG storage fixed installations; part 2 – small bulk installations for domestic purposes	<ul style="list-style-type: none"> - Covers domestic premises - Should be used in conjunction with Code 1 Part 1, Code 1 Part 3 and Code 22 - States that pressure shall be controlled in at least 2 stages - Notes that Code 22 is 'in preparation'
1989	PSTGC 1989 Pressure Systems and Transportable Containers Regulations 1989	<ul style="list-style-type: none"> - Revoked and re-enacted by PSSR 2000 - Came into force apart from certain Regulations (e.g. on transportable gas containers) on 1 July 1990.
February 1990	LPGA COP 22 LPG Piping – System Design and Installation	<ul style="list-style-type: none"> - Guidance for those involved in the design and installation of LPG pipework systems; to give guidance on the selection of materials, the design, installation and testing of pipework for LPG liquid and vapour - Revised in 1996
1991	TD Minute 2B/INF/2/91 LPGITA COP 22: LPG Piping Systems – Design and Installation	- The minute introduces the LPGITA COP 22

April 1991	OC 286/98 LPGITA COP 22 Design and Installation	<ul style="list-style-type: none"> - Issued to Agricultural, Factory and quarries Inspectors and FCG specialist inspectors - It is almost a direct reproduction of TD Minute 2B/INF/2/91
October 1991	LPGA Code of Practice 1 Design, Installation and Maintenance of Bulk LPG Storage at Fixed Installations: Part 1 Design and Installation	<ul style="list-style-type: none"> - Revision of 1978 COP 1 - Now a 4 Part Code - Include vessels over 150 litres and the associated equipment up to but not including the consuming equipment - Revised in July 1998
1992	PUWER 1992 Provision and Use of Work Equipment Regulations 1992	<ul style="list-style-type: none"> - Implemented the parts of the European Use of Work Equipment Directive that applied to general work equipment - Contained the requirement to maintain work equipment, the definition of work equipment would include items using LPG, but where pipework was part of the installation/building, it was not covered
1992	MHSWR 1992 Management of Health and Safety at Work Regulations 1992	<ul style="list-style-type: none"> - Came into force as part of a package of six sets of Regulations to implement a number of EC Directives dealing with the health and safety of workers - MHSWR was the GB implementation, together with the existing HSWA of the Framework Directive (89/391/EEC) that had the objective of setting up general duties under which more specific Directives would sit - The key duties were that of carrying out a risk assessment and setting up health and safety arrangements under an effective management system - The aim was for all hazards to be identified, their risk assessed and those risks to be adequately managed
1992	Approved Code Of Practice (ACOP) and Guidance; Management of health and safety at work	<ul style="list-style-type: none"> - Describes the key duties of MHSWR 1992 including that of carrying out a risk assessment and setting up health and safety arrangements under an effective management system - The aim was for all hazards to be identified, their risk assessed and those risks to be adequately managed
1992	Planning (Hazardous Substances) Regulations	<ul style="list-style-type: none"> - With the Town and Country Planning (Hazardous Substances (Scotland)) Regulations 1993 implement the land use planning requirements of the European Union Seveso II Directive - The regulations require sites with hazardous substances present above certain thresholds to seek consent from the local planning authority
1993	Town and Country Planning (Hazardous Substances (Scotland)) Regulations 1993	<ul style="list-style-type: none"> - With the Planning (Hazardous Substances) Regulations 1992 implement the land use planning requirements of the European Union Seveso II Directive - The regulations require sites with hazardous substances present above certain thresholds to seek consent from the local planning authority
March 1993	IP13 2nd Edition Institute of Petroleum Model Code of Safe Practice part 13: Pressure Piping Systems Examination	<ul style="list-style-type: none"> - Supersedes first edition published in 1979 - Provides a guide to safe practices in the in-service examination and testing of piping systems in the petroleum and chemical industries, and consists primarily of scheduled examinations by Competent Persons
September 1994	IGE/UP/2 Procedure Gas Installation Pipework, boosters & compressors on industrial and commercial premises Communication No. 1598	<ul style="list-style-type: none"> - Guidance on the installation of gas pipework and certain ancillary equipment on industrial and commercial premises - Covers similar subject matter to former British Gas plc publications IM/16 and IM/15 - Scope includes installation pipework designed to convey 3rd family gases in the gaseous state, for a design pressure not exceeding 2 bar - IGE/UP/2 is referred to in the subsequent edition of LPGA COP 22 issued in June 2002

November 1994	IGE/TD/4 Edition 3 Gas Services Communication No.1562	<ul style="list-style-type: none"> - Extends the scope to reflect the predominant use of polyethylene pipe and the increasing use of LPG - For LPG the recommendations apply to services supplied from bulk storage vessel installations where the service pipe connects the first stage regulator to the emergency control valve.
December 1994	LPGA Code of Practice 1: Design, installation and maintenance of bulk LPG storage fixed installations; part 2 – small bulk installations for domestic and similar purposes	<ul style="list-style-type: none"> - Major revision in 2000 and an amendment in 2003
1995	THSD Minute THSD/A3/T/2/94 Pipelines for conveying LPG liquid and vapour	<ul style="list-style-type: none"> - Provides information primarily on the design, installation and testing of liquid and vapour pipelines within industrial buildings and premises
November 1995	OC 286/104 Pipelines for conveying LPG Liquid and Vapour	<ul style="list-style-type: none"> - Gave general guidance on the design, installation and testing of LPG pipelines and was based on THSD Minute THSD/A3/T/2/94. - The OC did not consider ongoing maintenance or inspection of pipework
1995	RIDDOR Reporting of Injuries, Diseases and Dangerous Occurrences Regulations	
February 1996	LPGA COP 22 LPG Piping – System Design and Installation	<ul style="list-style-type: none"> - Revision of 1990 COP 22 - Revised in 2002
1996	Pipelines Safety Regulations	<ul style="list-style-type: none"> - PSR regulates third party conveyance of a fluid through a pipeline from a primary source to a tertiary user
December 1997	LPGA: LPG Technical Fundamentals	<ul style="list-style-type: none"> - Notes that LPG does not affect metals but many non-metallic substances are chemically attacked by LPG
1997	FPWR 1997 Fire Precautions (Workplace) Regulations 1997	<ul style="list-style-type: none"> - Require employers to address general fire precautions concerning fire fighting, fire detection, and escape routes and to cooperate and coordinate on these matters with other employers on their site - It does not deal with process fire safety and so does not cover the siting and maintenance of gas and LPG pipework and equipment
1997	Town and Country Planning (Scotland) Act	
1998	CHANGE FROM CALOR GAS SUPPLY TO JOHNSTON OILS LTD SUPPLY	
1998	GSUR 1998 Gas Safety (Installation and Use) Regulations 1998	<ul style="list-style-type: none"> - Cover requirements for the safe installation and maintenance of gas appliances etc - Applies to domestic, retail and commercial premises but, save for regulations 37, 38 and 41 and subject to regulation 3(8), does not apply generally to 'factories' within the meaning of the Factories Act 1961
1998	HSC Approved Code of Practice: Design Construction and Installation of Gas Service Pipes: Pipeline Safety Regulations 1996	<ul style="list-style-type: none"> - Applies to all service pipe installations with a maximum operating pressure of up to 7 barg which connect to a natural gas distribution main

1998	PUWER 1998 Provision and Use of Work Equipment Regulations 1998	<ul style="list-style-type: none"> - Amends PUWER 1992 and implements a 1995 amendment to the European Use of Work Equipment Directive - Main changes concern mobile plant and power presses - Work equipment extended to include 'installations' - Employers were required to ensure work equipment exposed to conditions causing dangerous deterioration is inspected at suitable intervals - Applies to all work equipment this means that any items of a pressure system not covered by PSSR are covered by PUWER
1998	OM 1998/114 Guidance on storage of LPG	<ul style="list-style-type: none"> - Issued by Safety Unit to explain some changes in the format of guidance for LPG
July 1998	LPGA COP 1 Bulk LPG Storage at Fixed Installations: Part 1 Design, Installation and Operation of Vessels Located above Ground	<ul style="list-style-type: none"> - Revision of October 1991 COP 1 - First version to have a foreword by the Advisory Committee on Dangerous Substances (ACDS) - Aimed at those involved in the safe practice of storing and handling of LPG in bulk at fixed installations - Supersedes the 1991 edition of COP1 Part 1 for above ground vessels and HS(G)34 - Revised in February 2004
1998	PUWER 1998 ACOP and Guidance - Safe Use of Work Equipment L22	<ul style="list-style-type: none"> - Requires that if a risk assessment made under the MHSWR identifies a significant risk from the installation or use of work equipment then a suitable inspection should take place
1998 (3 rd Edition)	GS4 Safety in Pressure Testing HSE Guidance Note	<ul style="list-style-type: none"> - Provides guidance for pressure testing
1998	Health and Safety (Enforcing Authority Regulations)	<ul style="list-style-type: none"> - Sets out the allocation of enforcement responsibilities between the HSE and local authorities
January 1999	LPGA COP 1: Part 1	<ul style="list-style-type: none"> - Amendment to 1998 version
1999	Pressure Equipment Regulations 1999	<ul style="list-style-type: none"> - Deals with the supply of pressure equipment
1999	COMAH 1999	<ul style="list-style-type: none"> - Replaced CIMAH 1984 - Implemented the Seveso II Directive - Main aim is to prevent and mitigate the effects of those major accidents involving dangerous substances which can cause serious damage to people or the environment
December 1999	TM62 LPG Association Technical memorandum 62: Gas soundness testing of LPG service pipework, installation pipework and appliances	<ul style="list-style-type: none"> - Withdrawn after the publication of BS 5482 Part 1 in 2005 - Includes small commercial installations and pipework and appliances with a total internal volume of 0.02 m³ or less
1999	Management of Health and Safety at Work Regulations 1999	<ul style="list-style-type: none"> - Consolidates changes made since MHSWR 1992
October 1999	CHIS4 'Use of LPG in small bulk tanks' HSE Chemical Information Sheet 4	<ul style="list-style-type: none"> - After the withdrawal of HS(G)34 there was a need for free HSE guidance to be produced for small-scale users of LPG in bulk tanks - covers the hazards of LPG, precautions, and actions in the event of a fire or leak - Highlights the fact that LPG vapour is heavier than air and will collect in drains, gullies and cellars - Deals with the need to ensure there are adequate arrangements for inspection and maintenance of the tank and its equipment but states this is normally arranged by the LPG supplier

October 1999	CHISS 'Small scale use of LPG in cylinders' HSE Chemical Information Sheet 5	- Not applicable to the ICL Installation
December 1999	ACOP and guidance for Management of health and safety at work Regulations; L21 Second Edition	- Consolidates some changes made by amendments and to make clear the implementation of the Directive in some areas, in particular, the way and need to reduce unacceptable risks - Gives extensive information on how to carry out risk assessments, risk reduction and the management of health and safety
January 2000	LPGA Code of Practice 1: Design, installation and maintenance of bulk LPG storage fixed installations; <u>part 2</u> – small bulk installations for domestic and similar purposes (Revision)	- Revision of 1994 COP 1 Part 2 - Deals solely with vapour take-off, above ground, buried or mounded installations of 150-4500 litres water capacity where the LPG is stored under pressure at ambient temperatures in single fixed vessels
2000	LPGA Code of Practice 1: Bulk storage fixed installations; Part 3 – Examination & Inspection	- Revision of the 1986 COP 1 Part 3 - Gives guidance for items that have to be included in the written scheme of examination (WSE) of bulk LPG vessels having a capacity of 150 litres or more and those items to be included in the WSE of distribution systems up to the consuming equipment operating at pressures in excess of 0.5 barg - Reiterates the periodic inspection of underground pipes below 5 bar as requiring survey for leakage by pressure testing, gas detection etc - Assumed that the system had been designed and installed in accordance with COP 1 parts 1, 2 and 4 - Revised September 2006
February 2000	PSSR 2000 Pressure Systems Safety Regulations 2000	- Revoked and re-enacted PSTGC (1989) - Applies to all pressure systems with a 'relevant fluid' - Requires a Written Scheme of Examination to be drawn up by a competent person
April 2000	OM2000/113	- Explains that the PSSR 2000 Regulations revoke and re-enact with minor changes the PSTGC 1989
2000	PSSR 2000, ACOP Safety of Pressure Systems L122	- Described the changes between PSTGC 1989 and PSSR 2000 - Changes were mainly connected with the introduction Carriage of Dangerous Goods legislations that had revoked 7 of the regulations and the introduction of the Pressure Equipment Regulations 1999
2000	HELA LAC 66/8 Pressure Systems Safety Regulations 2000 Issues of Interpretation	- Gives a basic interpretation of terms used in PSSR such as competent person, relevant fluid etc
2000	HELA LAC 52/15 (rev May 2000)	- Makes enforcement officers aware of the existence of a flexible pipe which may have a use on autogas forecourts where buried pipe is used between the LPG vessel and the dispenser
2000	Building Regulations	- These regulations apply to England and Wales under the Building Act 1984
2001	NFPA 58 American National Fire Protection Association Code 58 – update of 1963 version	- Applies to the operation of LPG containers, piping and associated equipment when delivering LPG to a building for use as a fuel gas - Includes discussion on protecting buried pipework from traffic loading and corrosion - Requires that owners or operators of LPG bulk or industrial systems shall prepare and implement procedures to maintain the ongoing mechanical integrity of the LPG systems

2002	Amendments to Workplace (Health, Safety and Welfare) Regulations	- Regulation 4A concerning the stability of buildings was introduced by way of an amendment in SI 2174/2002; Health and Safety (Miscellaneous Provisions) Regulations 2002
June 2002	LPGA COP 22	- Revision of 1996 COP 22 - Does not contain a foreword from HSE's ACDS because its contents are outside the scope of previous HSE guidance
2002	OC 284/7 DSEAR 2002 SI 2002/2776	- Produced by FOC SU to announce DSEAR and describe the requirements of the legislation and the inspection/enforcement approach
2002	COSHH Control of substances hazardous to health	
2002	HSE INDG370 Leaflet: Fire and Explosion: How Safe is your workplace?	- Provides further guidance on DSEAR
January 2003	LPGA Code of Practice 1: Design, installation and maintenance of bulk LPG storage fixed installations; part 2 – small bulk installations for domestic and similar purposes (revision 2)	- Revision of 2000 COP 1 Part 2
May 2003	DSEAR Dangerous substances and explosive atmospheres L138	ACOP
May 2003	DSEAR Storage of dangerous substances L135	ACOP
May 2003	DSEAR Control and mitigation measures L136	ACOP
May 2003	DSEAR Safe maintenance, repair and cleaning procedure L137	ACOP
February 2004	LPGA COP 1 Part 1 Revised	- Revision of July 1998 COP 1 - More detailed in its application to existing installations
11 May 2004	DATE OF EXPLOSION	
July 2004	HELA LAC 65/54a	- Concerned the investigations into two incidents that occurred at petrol filling stations with LPG installations that identified serious weaknesses in the installation of some LPG pipework and in the sealing of underground ducts
September 2004	HSE HID Short Life Circular	- Sent to HSE Inspectors regarding the LPGA Codes of Practice and ALARP
November 2004	HSE Discipline Information Note CD5/059: Developing an inspection strategy to ensure the ongoing integrity of buried metallic pipework	- Internal technical note to process safety and mechanical engineering specialist inspectors. It included further information on buried metal pipework
2005	Building (Scotland) Act 2005	- This Act repeals the Building (Scotland) Acts of 1959 and 1970
2005	Building (Scotland) Regulations 2005	- Under the Building (Scotland) Act 2005 aim to ensure the safety of people in and around buildings, whether domestic or commercial.

2005	Fire (Scotland) Act	- The onus is on the owner or occupier of premises to prepare a written fire assessment, focussing on the use of the building, its construction and the potential for a fire.
2005	Regulatory Reform (Fire Safety) Order 2005	- Deals with fire safety in non domestic premises
April 2005	HSE OM 2000/113	- Guidance to HSE inspectors regarding PSSR 2000
June 2005	COMAH (Amendment) Regulations 2005	- Broadens the scope of COMAH - Reflects changes in Seveso II
December 2005	BS 5482 Part 1: Domestic butane- and propane-gas-burning installations	- Withdrew TM62 1999
March 2006	HSE Leaflet: 'Checking LPG pipework'	- This HSE leaflet was sent to all LPG users through the LPG suppliers
June 2006	HSE INDG163 Leaflet: Five steps to risk assessment	- Provides employers with advice regarding risk assessments - Produced in 1998, revised in 2002 and reissued in 2006
September 2006	LPGA Code of Practice 1: Bulk storage fixed installations; Part 3 – Examination & Inspection	- Revised 2000 version - Included an expanded section on what an inspection regime should consider
March 2007	Technical Memorandum 84: Inspection and maintenance of LPG pipework at commercial and industrial premises	- It outlines the need for pipework owners to inspect and maintain LPG pipework in order to ensure its continued safe operation
January 2008	User Information Sheet 015: Inspection and maintenance of LPG pipework at commercial and industrial premises	- This is a reprint of Technical Memorandum 84 by UKLPG - There are no differences from Technical Memorandum 84
April 2008	OC 286/105 The ongoing integrity of buried, metallic LPG pipework – inspection and enforcement considerations	- This is a follow on from DIN CD5/059 - Aimed at all inspectors
September 2008	Draft UKLPG Code of Practice 22	- Redrafted to take account of revised guidance in relation to underground metallic LPG pipework - Still in draft form
January 2009	UKLPG Code of Practice 1: Part 1	- Revision from 2004 edition

Appendix 4 – The history of the Inquiry

The Inquiry: Terms of Reference

On 1 October 2007 the Lord Advocate, the Rt Hon Eilish Angiolini QC, and the then Secretary of State for Work and Pensions, the Rt Hon Peter Hain MP, announced that a joint public inquiry under the Inquiries Act 2005 (the 2005 Act) would be held in Scotland into the circumstances of the disaster. The Inquiry was to be a joint inquiry since health and safety matters were not within the competence of the Scottish Ministers. The Inquiry might however consider matters relating to Scotland that were not reserved.

This was the first inquiry in Scotland, and the first joint inquiry, to be held under the 2005 Act, and the second to be held since inception.

On 5 December 2007 it was announced that I was to be the Chairman of the Inquiry and that the Inquiry's Terms of Reference, as agreed between Scottish Ministers and the Secretary of State for Work and Pensions, were to be:

- To inquire into the circumstances leading up to the incident on 11 May 2004 at the premises occupied by the ICL group of companies, Grovepark Mills, Maryhill, Glasgow
- To consider the safety and related issues arising from such an inquiry, including the regulation of the activities at Grovepark Mills
- To make recommendations in the light of the lessons identified from the causation and circumstances leading up to the incident
- To report as soon as practicable.

By Instrument of Appointment, dated 15 and 17 January 2008 the Secretary of State for Work and Pensions and the Cabinet Secretary for Justice on behalf of the Scottish Ministers established the Inquiry with a setting up date of

21 January 2008 and formally appointed me as its Chairman. The Instrument of Appointment specified that the Inquiry would be subject to the Inquiries (Scotland) Rules 2007 (the 2007 Rules) made under section 32(3) of the 2005 Act. These rules were laid on 13 December 2007 and came into force on 19 January 2008.

Mr Roy Martin QC and Mr Kenny McBrearty, Advocate, were appointed as counsel to the Inquiry.

On 21 January 2008, Ms Jillian Glass, of HM Treasury Solicitor's Department, Government Legal Services, was appointed as Solicitor to the Inquiry.

Setting up the Inquiry

When she announced the Inquiry the Lord Advocate said that she intended that it would open on Tuesday 8 April 2008. On 7 December 2007 the Procurator Fiscal wrote to the bereaved families and injured survivors to this effect.

In the event, it became apparent that the essential preparatory work would necessitate a later start to the hearings. The Solicitor to the Inquiry at once began to establish the Inquiry Secretariat; appoint staff; procure office premises; secure a suitable venue for public hearings; prepare budgets and establish financial and accounting relationships with the Scottish Ministers; register under the Data Protection Act 1998; draft procedures and protocols for the purposes of the 2007 Rules and the 2005 Act; establish a website, obtain the release and use of the evidence for the criminal case from the Crown Office and obtain further evidence relevant to the remit,

and procure technical support for the recording of Inquiry documentation and its electronic presentation in public hearings together with transcription of evidence for daily posting on the website during the public hearings.

Premises

Offices

An office was leased on 18 February 2008 from Edinburgh Council at Lothian Chambers and was occupied in the week of 3 March 2008. The proximity of the office to the Court of Session gave ready access between the Inquiry Team, the Chairman and counsel.

Venue

An extensive search for a venue in Glasgow for the Inquiry hearings had begun in November 2007. Several available venues had to be ruled out on grounds of cost, unavailability, accessibility or security. Glasgow High Court and Glasgow Sheriff Court were discounted since both facilities were under considerable pressure from the volume of their normal business.

The Community Central Hall at Maryhill is owned by a community development charity that provides facilities and services including care for the elderly, youth projects, training programmes and opportunities for the benefit and well being of the community. It was chosen as the venue in February because of its facilities and its accessibility to the community most closely affected by the disaster. The necessary refurbishment of the Hall has left a lasting benefit to the local community. In the days immediately after the explosion the Hall provided support to the rescue services and refuge for families and friends. A memorial service was subsequently held there. It continues

to provide a meeting place for some of those affected by the disaster. A further public inquiry has since been held there. This has extended the benefit of the expenditure incurred by this Inquiry.

On 4 April 2008 it was announced that the Community Central Hall would be the venue for the Inquiry. Relatives and survivors were divided in their views as to the choice of venue. I greatly regret that this caused upset to some.

Obtaining and review of evidence

The underground pipe that failed had been installed 35 years before the explosion. The evidence about its installation was sparse.

I intended that the Inquiry would be open and transparent. Accordingly, the Inquiry team notified those providing documents and information that such evidence was likely to become public at some stage of the Inquiry. I gave an assurance that I would use any evidence provided to me only for the purposes of fulfilling my remit.

I invited anyone who held relevant evidence to supply it to the Inquiry and to inform the Inquiry Solicitor of any reason why it should be treated as confidential. It would then be possible for me to consider in each case whether a restriction notice under section 19 of the 2005 Act would be appropriate.

Criminal evidence

The Crown held the evidence gathered for the criminal prosecution. On 21 December 2007 the Procurator Fiscal supplied copies of the Crown productions and core police statements to counsel to the Inquiry.

In January 2008 the Inquiry Solicitor, junior counsel to the Inquiry and the Procurator Fiscal met to discuss the scope of the criminal investigation, the nature of the information held by Crown Office and any legal constraints that might affect the use of the evidence by the Inquiry. During March and April, the Crown gave the Inquiry Team access to its productions and statements, including a further 923 police statements.

This material greatly assisted the Inquiry.

The Inquiry did not examine any personal medical records. The Crown did not provide investigation information that was not produced in evidence.

In late April and early May 2008, as a matter of courtesy, Crown Office wrote to the witnesses from whom the Inquiry wished to seek assistance, enclosing copies of their precognitions. It informed the witnesses that the Inquiry would be approaching them directly.

The Inquiry Team sent draft statements and where relevant further questions to the witnesses concerned incorporating relevant information from the Crown statements and precognitions together with copies of any documentation referred to in the drafts. The team asked each witness to answer any questions and to confirm or amend the draft statement. Any amended statements were returned to the witnesses for signature.

On 2 May sixty two draft Inquiry statements were sent out to witnesses with a request that they be returned no later than 12 May 2008. I am indebted to the witnesses, and the lawyers assisting them, for their co-operation. It enabled

the Inquiry to disclose these statements to the core participants before the public hearings and to adhere to the start date of 2 July.

Material recovered in the course of the criminal investigation but not available for review for relevance by the Inquiry

Among the productions were numerous documents recovered from the site. Some had been recovered directly. Others had been retrieved from the debris that was removed from the site. All of the rubble and the remains of the building had been removed by skip under controlled conditions to another secure site. For several weeks thereafter police officers sifted the debris. They retrieved 1276 one-tonne bags of documents. Papers relating to the building, and to LPG and Health and Safety matters, but not considered to be of evidential value, were kept in about 40 boxes. They were reviewed by the Procurator Fiscal and by the ICL companies' lawyers.

The Inquiry Team requested access to these boxes. The Procurator Fiscal then learned that they were no longer available. They had been stored in a container that vandals had set on fire.

Other evidence obtained

The Inquiry Team's investigations produced further relevant information which was published on the website.

Extensive questionnaires were submitted to Calor Gas, Johnson Oils, UKLPG and HSE after Stage 1. This exercise provided a volume of useful information for Stage 2.

The Inquiry's own electronic database references were substituted for the Crown Office production references for the purposes of the hearings. The Crown Office retained the originals of the productions.

Disclosure to core participants

On 1 May 2008 the Crown provided the productions to the Inquiry electronically. This enabled the Inquiry to disclose them electronically to the core participants.

The Crown confirmed that all productions could be made available to the core participants regardless of their relevance to the terms of reference. Of the core participants, previously only ICL had had access to all productions in the criminal case. The Inquiry Team identified the documents relevant to the terms of reference. These were disclosed as the Inquiry bundle. The remaining productions not considered to be relevant were disclosed to core participants in a separate electronic disk.

During the Inquiry further material was added to the Inquiry bundle.

Inquiry Bundle – Stage 1

On 16 May 2008, following receipt of signed confidentiality undertakings, the Inquiry bundle was disclosed to core participants. It consisted of 3 disks.

Disk 1 was subdivided into 3 sections – Guidance, Expert and Other. "Guidance" consisted of legislation, codes of practice and guidance notes. "Expert" consisted of various expert reports. "Other" consisted of miscellaneous documentation relevant to the Inquiry. This disk was re-issued on 19 June 2008. A finalised version was issued on 24

June 2008. On 7 August, after Stage 1, Disk 1 was re-issued to core participants' recognised legal representatives together with the documents added and statements used during Stage 1.

Disk 2 contained Crown productions that I considered not to be relevant to the Inquiry. It was left to each recognised legal representative to decide whether to review this material. No participant relied on any of it. Other materials such as police production reports and a large number of photographs were yet to be reviewed for relevance and were excluded. On 19 June 2008 the final version of this disk was issued to core participants.

Disk 3 contained the finalised Inquiry statements for Stage 1. On 4 June 2008 this disk was re-issued to core participants with fully referenced statements and a provisional list of witnesses. On 23 June 2008 the finalised disk was issued along with the final list of witnesses for Stage 1.

Four core participants represented themselves at the Inquiry. During June they were given access to the Inquiry bundle by members of the Inquiry Team.

Inquiry Bundle – Stage 2

On 14 October 2008, the Inquiry team disclosed an updated version of Disk 1 to the core participants. All documents added to it were marked as "added for Phase 2". On 17 October, the team disclosed a further 24 documents as part of the Inquiry bundle. On 29 October, the team disclosed a few additional documents and the referenced statements to the core participants.

Other reports and documents

On 27 June 2008, the Inquiry issued a HSE DVD showing the smoke test carried out on the ICL pipework and a police DVD showing the recovery of evidence. As the recognised legal representative for a number of the bereaved families and survivors, Mr McGuire was asked to advise the Inquiry in writing if any of them thought that these might cause distress. The Inquiry received no correspondence on this matter from Mr McGuire.

Undertakings as to confidentiality

On 16 May I released the Inquiry disks having received professional undertakings as to confidentiality from the recognised legal representatives of the core participants. These undertakings were to apply to the disks and to all further documents and information provided in the course of the Inquiry.

The undertakings specified that hard copies of documents were to be made only for specific purposes and were to be retained within the firm, with no disclosure to be made to any third party; that the recognised legal representatives were permitted to give their clients access to the documents in their offices, subject to specific exceptions; and that all documents and information supplied in the course of the Inquiry were to be destroyed within a month of the delivery of my Report to Ministers.

Members of the Inquiry Team gave those core participants who represented themselves the opportunity to read this material.

Core participants also provided undertakings.

Breach of professional undertaking by Mr Patrick McGuire

In the course of the second week of the public hearings it came to my attention that Mr Patrick McGuire, of Thompsons had broken his personal professional undertaking to me by having given hard copies of statements to certain of his clients in advance of their being published on the Inquiry website. It appears that Mr McGuire gave these copies to those core participants who had been clients of Thompsons before the Inquiry but not to any of those who had been represented earlier by two other firms of solicitors.

Mr McGuire wrote to the Solicitor to the Inquiry and expressed his sincere and unreserved apologies. He accepted that he had broken his personal professional undertaking. He said that he had misread it and had failed to notice that access could only be given at his firm's premises. He said that his breach of the undertaking had not been deliberate. He said that he had arranged for the return of the statements from those to whom he had sent copies and that he deeply regretted the incident.

In the event it appears that Mr McGuire's breach of his undertaking did not seriously prejudice the conduct of the Inquiry.

First Preliminary Hearing

On 5 February 2008 I announced that the first preliminary hearing would take place on 25 February.

The Inquiry website went live on Friday 22 February.

At the first preliminary hearing I said that I would conduct the Inquiry in two stages. The first would deal with the factual circumstances leading to the explosion and safety and related matters, including regulatory issues arising from that examination. The second would consider the lessons to be learned and the recommendations to be made.

I invited those who wished to be core participants to apply to me in writing. I drew attention to the provisions under which I could require two or more core participants to have a single legal representative where their interests in the outcome of the Inquiry were similar, where the facts on which they were likely to rely were similar and where it was fair and proper for them to be jointly represented. I also made clear that it was not necessary for a core participant to be legally represented.

I indicated that, at the conclusion of each stage of the Inquiry, I would receive notes of the core participants' proposed findings in fact, and of suggested lessons to be learned, and any proposed recommendations and closing submissions.

I invited any interested person to submit representations on any matter that might fall within the terms of reference.

I intended to receive all relevant information in written form within a timetable. Where oral evidence was to be given, I required that core participants who wished to examine any witness should apply in writing specifying the topics that they wished to raise.

On 4 March 2008 the Inquiry Solicitor wrote to the bereaved families and survivors

repeating my concern that they should have every opportunity to express their views and concerns. She enclosed a note explaining the requirements for an application to be a core participant.

Second Preliminary Hearing

On 8 April 2008, at the second preliminary hearing, I gave my decision as to the parties who were to be admitted as core participants. The list of core participants is set out in Appendix 1. In relation to next of kin I admitted a single representative, being the surviving spouse, where applicable, or the eldest child, failing which either parent. I invited representations with regard to any particular circumstances. I rejected applications from insurers. Individual HSE inspectors reserved their position. I decided that the question as to whether any core participant should be admitted to all or part of the Inquiry should be kept under review.

I invited interested persons to submit concise statements of case by 16 May setting out the issues that they wished me to consider, having regard to my terms of reference, and those aspects of the circumstances leading up to the explosion that they wished the Inquiry to investigate. I also invited core participants to notify me of the topics on which they wished to participate, the matters that they sought to establish on each and their view of the relevance of those matters to my terms of reference.

I wished to maintain a flexible approach and to proceed on a full disclosure of the positions of those interested from the outset.

On 22 April 2008 there was a meeting between the Inquiry Solicitor, the legal representatives of the core participants and the unrepresented core participants to discuss the arrangements for the Inquiry.

On 2 May 2008, I published the Inquiry Procedures document on the Inquiry website.

On the same date I published the Inquiry Protocol setting out the procedures to be followed in respect of applications for legal representation.

On 16 May 2008, I issued my determination as to the test as to financial resources for the purposes of public funding. I made an advance allowance for reading time to enable Thompsons and their counsel to read the material. This was not utilised.

On 10 June 2008, I issued my decision on the applications for funding for legal representation at public expense by those core participants who were next of kin or were injured survivors.

The deadline for applications to question witnesses in Stage 1 was 16 June. In the event the group represented by Thompsons did not submit applications until 1 July. As their role was not pivotal to the outcome of the Inquiry, this delay did not unduly disrupt it.

First application for funding at public expense

By letter dated 22 February 2008, Thompsons, on behalf of themselves and Levy and McRae, Solicitors (Levy and McRae), notified me that they collectively represented all of the injured victims and the families of the deceased. They mentioned that another firm, Austin Lafferty and

Company (Austin Lafferty), represented some of the victims, but that they would be dealing with the matter on their own. Thompsons said that they proposed to instruct one set of counsel consisting of a leader and two juniors. They applied for an award of legal costs. They set out an estimate of 400 hours preparation work by solicitors at £200 per hour with a charge of £500 per day for each firm to attend at the Inquiry. They estimated that 40 days would be required for preparation by counsel at rates of £250 per hour for leading counsel and £175 per hour for junior counsel. Counsel's fees would amount to, in all, £7,000 per day during the hearings. The letter recorded that it would be necessary to obtain expert evidence for the families and victims, that this would involve further work and expenditure estimated at £15,000 plus additional solicitor's time, and that the inquiry hearings would last for several months.

I made it clear at the preliminary hearing on 25 February 2008 that until I made my decision on the applications for core participant status, no question of funding could arise. On 8 April, I granted core participant status to the next of kin of those who died and to the injured survivors.

Funding at public expense

The legislation recognises that the length and cost of public inquiries depends to an extent on the amount of publicly funded representation and on the role that legal representatives are permitted to play in the proceedings. In 1990 the then Attorney General said that "In general, the Government accept the need to pay out of public funds the reasonable costs of any necessary party to the Inquiry who would be prejudiced in seeking representation were he in any doubt about funds becoming available.

The Government do not accept that the costs of substantial bodies should be met from public funds unless there are special circumstances.”

The power of a Chairman to make an award of public funding is restricted by statute to payments of compensation for loss of time, expenses properly incurred in attendance at the Inquiry, and to fees for legal representation where a person is providing evidence, or is a person who, in the opinion of the Chairman, has a particular interest in the proceedings or outcome of the Inquiry that justifies such an award.

A Chairman must act with fairness and with regard to section 17 of the 2005 Act and must avoid any unnecessary costs, whether to public funds, witnesses or others. He is also required to comply with any Determination issued by Ministers under section 40.

On 21 February 2008, the Ministers exercised their powers under section 40 and issued a Notice of Determination prescribing qualifications and conditions on my power to award amounts in respect of legal representation and setting a maximum on the fees to be allowed.

The Determination related to the payment of legal expenses from public funds. It provided *inter alia* that payment could be made only in circumstances where the Chairman considered it to be fair, reasonable and proportionate and that any award must be subject to the condition that payment would be made only for work evidenced as having been done in a cost effective and efficient manner, where unnecessary duplication had been avoided and the best use of funds had been made. Any

award had to specify the nature and scope of work to be carried out. As an Inquiry under the 2005 Act is inquisitorial in nature, no payment was permitted for work of an investigative nature or in relation to the obtaining of expert reports without express permission given in advance. The Determination prescribed maximum hourly rates and the maximum number of hours for which solicitors could charge. Retrospective awards were forbidden.

Scottish Ministers and the Secretary for State for Work and Pensions also determined the rate of remuneration for counsel to the Inquiry in accordance with section 39 of the 2005 Act.

In making any award the Rules require the Chairman to take into account the financial resources of an applicant and the public interest. I therefore had to decide what would be the legitimate, proportionate and fair tests to apply in allowing funding at public expense.

After the first preliminary hearing I received applications to be core participants from, among others, bereaved family members and injured survivors. Taking into consideration all the circumstances, including expectations that had been raised in the period before the setting up date, I admitted them as individual core participants. Those who represented themselves were given help by the Inquiry Team. Mrs Ferguson and Mrs Smith, who attended on every day of the Inquiry, greatly impressed me with their approach. Their questions were particularly helpful. I invited others who had been injured or bereaved, and who did not wish to be core participants, to submit questions in writing.

One of the primary considerations underlying the 2005 Act and the 2007 Rules is the

avoidance of multiple representations of persons who have had an identity of interest. There is also the important consideration of cost. I therefore invited the three legal firms representing a number of the bereaved families and injured survivors to reach an agreement on a single joint representation.

When that was agreed, they could apply for public funding for legal expenses. Levy and McRae indicated that the legal aid tests would not be acceptable. A number of the families were said to object to any suggestion as to means testing.

In the course of consideration of this MPs, MSPs and others involved themselves directly in this issue. Patricia Ferguson MSP, Ann McKechin MP, the STUC and representatives of the bereaved families sought a meeting with Kenny MacAskill MSP, Cabinet Secretary for Justice, to discuss a number of concerns they had in relation to the running of the Inquiry. The meeting took place on 14 May 2008.

At that meeting I understand concern was expressed that the bereaved families and survivors might be expected to pay for legal representation if they were unable to satisfy a test for financial assistance. It was asserted by those concerned that Ministers had assured them that the Government would meet their legal costs in full. I was unaware of any such assurances which, in my opinion, would have been outwith their gift.

There was also a concern expressed by the families that if they had to make a financial contribution towards legal representation, the contribution would somehow be paid to the Government. On 4 June 2008 the Minister

for Justice and the Secretary of State for Work and Pensions jointly wrote to me confirming that the question of legal representation of core participants at public expense was a matter for the Inquiry Chairman and that this had been made clear by the Cabinet Secretary for Justice at the meeting on 14 May. The Ministers also confirmed that their respective departments had a budget in place jointly to fund the Inquiry and that there was no desire on the part of the Scottish and UK Governments to require any contribution from the families towards the costs of the Inquiry.

On 16 May I issued a determination setting out the criteria that I intended to adopt in applying Rule 18 of the 2007 Rules. Rule 18 requires the Chairman to take into account the financial resources of an applicant together with the public interest when considering making an award pursuant to an application under section 40 of the Act.

I had previously invited core participants to make representations to me as to the appropriate criteria for the Rule 18 requirement. I received no representations on the matter, other than the oral comment to the Inquiry team from a representative for some of the bereaved families that the test for legal aid would not be appropriate.

At least one of the next of kin was concerned that he might be disqualified from being a core participant because his income was slightly over the threshold set in my determination of 16 May. I made it clear that none of the next of kin was at risk of being excluded as a core participant. It was open to all or any of the next of kin to represent themselves if an award should not be made, or to pay for

representation on their own behalf. I repeated my opinion that it was not necessary for a core participant to be legally represented. I also made it clear that where a core participant's income exceeded the threshold, I was willing to receive representations and to consider whether to make an award in the circumstances of the case. In the event, no core participant was excluded from participating in the Inquiry on financial grounds.

In my determination of 16 May, I directed that those core participants who were next of kin or were injured survivors were to have single legal representation. Thompsons had informed the Inquiry by a letter dated 2 May that "agreement" had been reached. Thereafter I confirmed Mr Patrick McGuire to be the grouping's single recognised legal representative.

The funding permitted under the award was initially for consideration of the evidence contained in Inquiry bundle, making applications for any questions, and attending oral hearings so far as necessary properly to represent their clients' interests. Funding was then granted for specific items of work.

The only other funding at public expense was for some small incidental costs of less than £1000 in all.

Statements of case

The statements of case were published on the Inquiry website.

Interested persons submitting statements included IOSH, Prospect (a Trade Union), STUC, Mrs Ann McKechin MP on behalf of Mr Connelly, Mr Connelly, Strathclyde University,

Families against Corporate Killers, Mr Alistair McNab (an HSE Inspector), and the Fire Brigades Union. On 9 June 2008 I published my response to the initial statements of case.

The issues raised in statements of case submitted by interested persons were as follows.

IOSH

The Scottish Health and Safety system and its application at ICL; compliance with Health and Safety and Fire Regulations; and training of ICL staff in OSH matters.

Prospect

Guidance to HSE inspectors on dangers of leaks from underground LPG pipework; communication of incidents to HSE field inspectors; and financial pressures on HSE.

STUC

The extension of the rights of trade union appointed health and safety representatives to inspect workplaces and employers where trade unions are not recognised.

Ann McKechin MP

The handling of Mr Connelly's complaints by ICL and HSE

Mr Connelly

The attitude of ICL management to health and safety issues; exposure of staff to hazardous substances; lack of personal protection clothing and equipment for staff; and poor communication of health and safety issues to staff within ICL.

Strathclyde University

Hostility of ICL management to trade unionism; oppressive approach within ICL to employer/

employee relations; exposure of employees to hazardous substances; deficiencies in health and safety training, instruction supervision and communication systems within ICL ; and deficiencies in oversight of ICL by HSE.

Families Against Corporate Killing

Financial benefit to ICL companies arising from the explosion; and HSE funding.

Mr McNab

A number of issues including actions by ICL and Calor, the matter of multiplicity of LPG guidance and the dissemination of information to HSE inspectors regarding similar incidents involving LPG.

Fire Brigade Union

The role played by Fire Safety Inspecting Officers; similarity with previous incident; and current regulatory framework.

Stage 1 hearings - 2 to 22 July 2008

Some witness statements that did not give rise to further questioning were read into the Inquiry record. Some witnesses were given the option to attend in person to read their own statement or to have their statement read on their behalf. Some were called to give oral evidence, four of whom were excused on health or compassionate grounds. Their statements were read into the record. Questions for witnesses who did not attend were put to them in writing. Their answers were circulated and published. Throughout the Inquiry I maintained an open invitation to injured survivors and bereaved families to submit questions in writing to any witness.

The topics addressed in Stage 1 were as follows:

1. The identity of those who died and those who were injured;
2. The circumstances leading up to the incident;
3. The history of the ICL Group and the occupation and use of Grovepark Mills;
4. The history of the buildings at Grovepark Mills and the processes carried out there;
5. The history and use of the LPG installation at Grovepark Mills;
6. The history of the regulation and inspection of the LPG installation;
7. The cause of the explosion.

The list of the witnesses Stage 1 is set out at Appendix 2.

The LiveNote© technology enabled a verbatim transcription of the evidence to be displayed in real time on the core participants' laptops. The transcripts were published on the Inquiry website shortly after the morning and afternoon sessions.

The Inquiry documents were displayed on monitors by electronic document presentation equipment. The proceedings, including document presentation, were transmitted in sound and vision to a dedicated media suite and to two separate rooms set aside for the family members and survivors.

At the end of Stage 1, I requested the core participants to submit to me by 15 August 2008, their proposed findings-in-fact, and a note of the evidence on which each was based. I waived this requirement in respect of those core participants who were without legal representation.

I also requested core participants to submit to me by 15 August, a note of any proposed lessons to be learned from the facts established in Stage 1. I invited core participants to suggest what measures could have prevented this tragedy and what inspection or oversight regime would be appropriate to ensure the safe and proper installation and maintenance of LPG pipes on small commercial premises.

I invited any other interested persons to make similar submissions. I received submissions from Prospect and Mr Tyldesley.

Stage 2 Preparations

In August, I commissioned a report from Mr Rod Sylvester-Evans which considered possible improvements to the current LPG regime, particularly as it related to LPG pipework at small industrial and commercial bulk user sites. I invited core participants to submit their proposed recommendations and their responses to Mr Sylvester-Evans' report by 26 September 2008.

Notice to Core Participants - 8 September 2008

This notice, amongst other things, set a timetable for the submission of proposed recommendations by core participants and any further representations that they wished to submit, and for the circulation of submissions.

On 10 October 2008, I issued a determination indicating my proposals for procedure in Stage 2, together with a provisional list of witnesses.

Stage 2 hearings - 21-24 October 2008 and 4-7 November

The purpose of Stage 2 was to consider what recommendations might be made to Ministers

in the light of the lessons learned from the disaster.

The relevant material included the expert reports on the disaster. The focus of Stage 2 was on the regime of installation, maintenance and monitoring of LPG pipework. This included consideration of statutory and other guidance available to occupiers, the users and gas suppliers; and the position of HSE and the LPG industry.

Calor Gas Limited assisted the Inquiry greatly by providing a small demonstration tank to illustrate the constituent elements of an LPG installation.

In Stage 2, I heard evidence from witnesses from HSE on the recommendations proposed by Mr Sylvester-Evans. At the end of Stage 2, I asked Mr Sylvester-Evans to present modified conclusions and recommendations in the light of the evidence and submissions from core participants.

On 24 October 2008, I asked core participants to make closing submissions on 13 November. I also invited interested persons to submit written representations by 12 November. I received written representations from UKLPG, Mr Tyldesley, Stirling and Strathclyde Universities, the Institute of Gas Engineers and Managers (IGEM) and Shell Gas Limited.

On 13 November 2008, I heard closing statements from the core participants and concluded the hearing.

Consultation with LPG users

By the end of the Inquiry hearings, I had heard from directors and employees of the ICL companies, representatives of the gas industry,

LPG suppliers, regulators, bereaved families and survivors. I invited the CBI and UKLPG to identify for my benefit a range of small- and medium-sized LPG users who might wish to comment on the suggested recommendations.

I received comments from:

- Bernard Matthews Farms
- Countrywide Farmers plc
- British Holiday and Home Parks Association
- Trevelgue Holiday Park
- Greenfield Engineering

The responses broadly supported Mr Rod Sylvester-Evans' approach. They highlighted the need to secure pipework integrity and ownership, greater awareness and management of LPG hazards and risks, and improved communications between regulators, suppliers and users. They expressed concerns about the merits of a verification scheme and the risks of damage to buried pipes if they should be excavated for the purpose of inspection.

I am grateful to those LPG users who submitted their views.

Other interested persons

Mr Ronald Jamieson submitted his own observations as an interested person with a background in building design and construction. Mr Jamieson had certain views on some of the evidence led in Stage 1. His comments related to the cause of the explosion, the date and nature of the construction of the building, the geological conditions and the point of entry of LPG into the building. The Inquiry Solicitor met Mr Jamieson in October and December 2008 and June 2009 to clarify certain points that arose from the material that he had provided.

Mr Jamieson stressed that his submissions were for the information of the Inquiry and were not intended for wider circulation or publication. He agreed that the notes of these meetings would suffice to record the understanding that he wished the Inquiry to take from the papers that he had submitted. The notes of these meetings are on the Inquiry website.

Mr Arthur Cardwell contacted the Inquiry to draw my attention to a device that he had invented to detect a drop in gas flow and pressure and thereby indicate the possibility of a leak. The information before the Inquiry indicated that an escape of LPG from a corroded pipe would not necessarily cause a sufficient drop in pressure to trigger Mr Cardwell's device. Since LPG is used at low pressures, and since corroded pipes are often plugged by corrosion or soil, the escape of gas may be slow but continuous, and in consequence difficult to detect.

The ICL/Stockline Disaster: An independent report on working conditions prior to the explosion, 2007

In August 2007, before my own Inquiry was set up, a multi-disciplinary team of academics from the Universities of Strathclyde, Stirling, York and Liverpool published a report entitled *The ICL/Stockline Disaster: An independent report on working conditions prior to the explosion*. I read this report before I began my Inquiry. The terms of reference of the research team that prepared it, and its working methods, were different from mine.

The principal aims of the team, and of its report, were stated as being:

- To understand as fully as possible the circumstances and context within which the disaster occurred. These include the

company, its regulation, structure and financing, its work practices, employment relations, built environment and health and safety practices.

- To ensure that the experiences of those workers and ex-workers, who wanted their voices to be heard, were fully documented. Workers' experiences can be a vital source of knowledge in the prevention of future disasters. Workers' silence has all too often led to a lack of justice: legal, social and economic.
- To build up a picture of what working life was like inside the factory. To consider the role played by inspection, regulation and enforcement agencies that directly and indirectly determine the policies and practices of companies such as ICL Stockline.

The evidential base from which the team drew its conclusions consisted of interviews with seven present and former employees of ICL and Stockline. The evidence of six of these is quoted anonymously. The research team used "action research" methods involving "risk mapping" and "body mapping" exercises by which, according to the report (p 3), "workers provided unrivalled evidence of working conditions, potential hazards and symptoms of ill-health." The report covers matters such as the alleged management style of the Downie family, the alleged hostility of management towards trade unionism, and an allegedly oppressive management approach to employer/employee relations and to the fixing of pay and conditions. It alleges that management gave priority to cost minimisation and reduced workers' holiday entitlements; exposed employees to hazardous substances, including asbestos; gave them ineffective protection from dust and fumes, routinely disregarded health and

safety legislation and statutory regulations and seriously breached COSHH Regulations. The report also alleges that there was an incidence of respiratory complaints among employees and that there were deficiencies in health and safety training, instruction, supervision and communication systems.

The report also deals with the question of the higher rates of fatal and major industrial injuries in Scotland in comparison with those in the United Kingdom overall and with the alleged inadequacy of HSE's resources. It accuses HSE of certain shortcomings in enforcement generally and at Grovepark Mills in particular. It also deals in passing with alleged shortcomings in the system of small company auditing.

The research team's investigations appear to have been carried out with the co-operation of the ICL/Stockline Support Group, whose solicitors were one of the firms instructing counsel for the families and survivors in the Inquiry. I should record that counsel for the families and survivors did not rely on any part of this report. None of the core participants applied for it to be lodged as a production and none referred to it at any stage in the Inquiry.

The report is available at www.hazards.org/icldisaster/icl_stockline_report.pdf.

Appendix 5 – The ICL Inquiry Team

Jillian Glass	Solicitor to the Inquiry
Trevor Lodge	Secretary to the Inquiry
Kathryn McCartney	Deputy Solicitor to the Inquiry
Linda Craik	Office Manager (until September 2008)
Katy Mackenzie	Administrator
Meryl Skene	Legal assistant

COUNSEL TO THE INQUIRY

Roy Martin QC

Kenny McBrearty, Advocate

Appendix 6 – Definitions and glossary

DEFINITIONS

bara Absolute pressure measured in bar (1 bar = 14.5 psi)

barg Gauge pressure measured in bar (where 0 barg = 1 bara)

Hazard The potential for harm arising from an intrinsic property or disposition of something to cause detriment.

Installation Pipework downstream of the emergency control

Pipework valve to the gas appliance or plant

LPG supplier Used in this report to describe the LPG company supplying the bulk tank

LPG user Used in this report to describe the party who uses LPG in its process, plant or appliances

Service Pipework Pipe for supplying gas to the premises from a gas storage vessel, being any pipe between the gas storage vessel and the outlet of the emergency control

Risk The chance or likelihood that someone or something will be adversely affected in a stipulated way by the hazard.

GLOSSARY

ACDS Advisory Committee on Dangerous Substances

ACoP Approved Code of Practice

ACP Approved Competent Person

AEGLP European LPG Association

ALARP As low a risk as reasonably practicable

ALGED Association for Liquid Gas Equipment and Distributors (now part of UKLPG)

BLEVE Boiling Liquid Expanding Vapour Explosion

COIN Computer Operated Information

COMAH Control of Major Accident Hazards

CoP Code of Practice

COSHH Control of Substances Hazardous to Health

DIN Discipline Information Notice

DSEAR Dangerous Substances & Explosive Atmospheres Regulations

ECV Emergency Control Valve

FIC Factory Inspectorate Circular

FISM Factory Inspectorate Specialist Minute

FOD Field Operations Directorate, HSE

FPA Fire Protection Association

FSR First Stage Regulator

GSIUR Gas Safety (Installation and Use) Regulations

HELA Health and Safety Executive/Local Authority Enforcement Liaison Committee	MHSWR Management of Health & Safety at Work Regulations
HID Hazardous Installations Directorate, HSE	NAWR Noise at Work Regulations
HMFI Her Majesty's Factory Inspectorate	OC Operational Circular
HSE Health and Safety Executive	OM Operational Minute
HSL Health and Safety Laboratory	OSH Occupational Safety and Health
HSWA Health and Safety at Work etc Act	PER Pressure Equipment Regulations
ICP Independent Competent Person	PSSR Pressure Systems Safety Regulations
IGE Institution of Gas Engineers (now IGEM)	PUWER Provision and Use of Work Equipment
IGEM Institution of Gas Engineers and Managers	RIDDOR Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
IOSH Institute of Occupational Safety and Health	RSP Relevant Statutory Provisions
LA Local Authority	SME Small or Medium-Sized Enterprise
LPG Liquefied Petroleum Gas	THSD Technology and Health Services Division, HSE (now Directorate of Science and Technology)
LPGA LPG Association (now UKLPG)	TM Technical Memorandum
LPGITA LPG Industry Technical Association	VOTV Vapour Offtake Valve
LPGITC LPG Industry Technical Committee	WHSWR Workplace (Health, Safety and Welfare) Regulations
MAH Major Accident Hazard	WSE Written Scheme of Examination
MAPP Major Accident Prevention Policy	

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