



# Cylinder controls

London fire commissioner Sir Ken Knight outlines current moves to introduce improved controls for acetylene gas cylinders

**T**HE LONDON Fire and Emergency Planning Authority (LFEPa) is currently working with key stakeholders to consider measures to reduce the potential dangers and disruption arising from fires involving acetylene gas cylinders.

On average, London Fire Brigade attends one incident a week where acetylene cylinders are reported at a fire. Over a quarter of these involve the cylinders themselves. Indeed, in September and October 2006 alone, there were six acetylene cylinder incidents in the capital.

Acetylene presents a unique risk, in comparison to all other bottled gases, due to its instability. Heating or mechanical shock can cause the acetylene to heat up and possibly explode. This can put the public and firefighters at immediate risk and lead to massive consequential disruption and financial loss in the public and private sector.

The risk of explosion can remain for up to 24 hours, unlike all other gases which are safe once the initial fire has been extinguished and the cylinder is cooled. In the past, whole acetylene cylinders and fragments have travelled nearly 200m following an explosion. Other dangers can include a travelling fireball, flying glass and structural damage to nearby buildings.

In May 2004, following a garage workshop fire, an acetylene cylinder was projected 150m. In another incident in southeast London, in September 2006, a cylinder was projected some 200m, having passed through a steel palling fence.

## **Hazard zone**

On Government, departmental and Health and Safety Executive (HSE) advice, each fire and rescue service in the UK is required to assume that a 200m radius around the cylinder is a hazard zone from which firefighters and the public may be excluded. The risk is such that the restricted (exclusion) zone is required to be in place for 24 hours after the fire has been extinguished, during which time the cylinder is cooled. There are examples where the hazard zone might be in place for some 48 hours after the fire was first reported.

The exclusion zone is restricted for both public and firefighter safety. Firefighters are required to withdraw from the building, to move to a position outside of the zone, and to adopt defensive firefighting techniques. The consequential fire loss is therefore potentially greater to the affected premises and any neighbouring premises than would be the case if a cylinder was not involved.

## Case studies

INCIDENTS INVOLVING acetylene cylinders at fires are a common cause of disruption in London and bring considerable risks to the public and firefighters. Examples of recent incidents include:

### King's Cross

On 26 June 2006, London Fire Brigade was called to a fire involving two acetylene gas cylinders suspended on the eighth floor of a construction site. The incident led to the evacuation of thousands of residents and workers, and a two-day suspension of overland trains running in and out of King's Cross.

Four fire engines and around 20 firefighters were called to the blaze. Fire crews closely monitored the condition of the cylinders. This included the use of thermal image pictures taken from a helicopter.

The following evening, once they had been cooled and declared safe, it was agreed that responsibility for the cylinders could be passed back to the building contractors. The cylinders were safely removed by the manufacturers to a place of safety and all cordons were removed.

### Hammersmith

Firefighters fought a workshop blaze involving an acetylene cylinder in Hammersmith on 2 February 2006. About 300 people were evacuated from the surrounding area and a 200m hazard zone was set up for 24 hours.

### Dagenham

At Dagenham in May 2004, an 80kg cylinder exploded following a garage workshop fire. The cylinder rocketed 150m into the air and landed on the roof of a house in a nearby street. The cylinder exploded before the brigade arrived and put a protective cordon in place to reduce the risk. No one was injured.

### Ealing

Overnight on 27 September 2006, a rubbish fire started behind a row of shops in South Ealing Road. With an acetylene cylinder on the site, a 200m exclusion zone was put in place as fire crews worked to cool the gas cylinder. The subsequent evacuation affected 500 homes, with 100 people leaving their homes. The discovery of the cylinder meant that two nearby primary schools had to be closed the following day, and traffic and public transport had to be rerouted ☐

Such restrictions can result in the closure of transport systems, the evacuation of the public from homes and buildings (and the subsequent need for family rest centres and local authority emergency planning arrangements), the closure of local businesses and community services and, as happened in one extreme case, the closure of hospitals.

During the period May 2003 to May 2005, there were 44 acetylene cylinder incidents in the capital. These caused major disruption to roads and public transport and many people were evacuated from their homes and businesses closed. In London in 2006 there have been major acetylene cylinder incidents in Hammersmith, where 300 people were evacuated, and in St John's Wood, when 60 people had to

leave their homes. In Essex, the M11 motorway was closed for 24 hours in February, causing traffic chaos and travel problems for Stansted Airport.

The social and economic disruption to London is apparent. We sometimes attract criticism for our national safety procedures – no one wants to be turned out of their home or business for 24 hours or face train cancellations. However, with the current evidence and advice that fire and rescue authorities receive, and with the responsibilities each has, fire authorities simply cannot compromise public and firefighter safety. But we recognise the massive disruption that can result. That is why a new approach is needed which reduces the number of acetylene cylinder incidents to an absolute minimum.

### Finding a solution

Current legislation is unlikely to be effective in dealing with acetylene gas cylinders in an appropriate way. The two main pieces of legislation that apply relate only to the transporting and construction/manufacture of cylinders. Beyond that, the HSE and the British Compressed Gas Association have both issued guidance notes on the safe use of acetylene. However, the Regulatory Reform (Fire Safety) Order is yet to be tested in this area.

LFEPa believes that a solution must be found to tackle this problem, and it is currently looking at options in partnership with the Government, HSE, the Chief Fire Officers' Association, the cylinder industry, the London boroughs and insurers. In fact, these stakeholders came together recently at a seminar in the capital to raise issues and to consider how to reduce the potential disruption arising from these incidents.

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**'LFEPa is not seeking to outlaw acetylene cylinders but there is a need to reduce their use to a minimum'**

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In addition, a few months ago LFEPa launched a new campaign on acetylene cylinders. The initiative's aims include working with government, the cylinder industry and business to introduce improved controls for the safe use, signage and storage of acetylene gas cylinders and to ensure they are followed. The campaign also seeks to raise greater awareness of the dangers when these cylinders are involved in fires and at other incidents.

LFEPa is not seeking to outlaw acetylene cylinders as this would not be practical – for example, given the mass building work now taking place in the city. But there is a need to reduce the use of these cylinders to a minimum, to make sure that the emergency services know where they are, and to continue to work on techniques for dealing with incidents when they do happen.

In Scandinavia, procedures allow the shooting of cylinders so as to put an end to the incidents much more quickly. The cylinder is shot with a high-velocity bullet three times in

quick succession, igniting the contents. Within 20 minutes, the contents have burnt off and the cylinder can be declared safe. This is an approach that should be further researched.

As an authority, LFEPA is dealing with a huge and sustained programme of building and development, which befits London as a world-class city hosting the Olympic Games in 2012 and as a major economic centre. We cannot afford to have this programme disrupted by incidents involving cylinders.

Following the mantra that prevention is better than cure, LFEPA is considering how the use of acetylene cylinders can be reduced as far as possible in favour of other hot-cutting alternatives. It also wants to consider the use of the Regulatory Reform (Fire Safety) Order, introduced in October 2006, to restrict the use of acetylene or to control its storage and safe working. As part of the London Safety Plan, fire safety teams will be targeting and identifying workplaces where acetylene cylinders are stored. The new fire safety legislation is an opportunity to advise businesses on the safe use, storage and transport of these cylinders.

Furthermore, the authority is looking at the possibility of new licensing arrangements for the storage and use of cylinders. It is also considering extending the concept of premises information boxes for sites where acetylene is stored or used. These boxes are currently widely used across London, in collaboration with GERDA, in a variety of buildings, including those with complex fire engineered solutions. They keep important information for responding firefighters on the risks they could encounter in the building.

When dealing with these incidents, London Fire Brigade needs to consider safe working operational tactics. Under its training programme, 50 hazardous materials officers have received expert training on acetylene cylinders with the industry. One of these officers attends every cylinder incident to give specialist advice, along with scientific advisers. A cylinder industry expert can also be called out under the agreed 'competent person call-out' procedures.

In addition, field trials have taken place using remote controlled robotic vehicles (ROVs), similar to those used by bomb disposal squads, to either remove the cylinder or provide blast containment. Enhanced camera equipment can also be placed on ROVs to provide colour and thermal imaging. The use of ROVs may not be suitable for all incidents, but it shows how LFEPA is actively pursuing solutions. The use of cryogenic cooling systems has also been suggested as a possible way of cooling the cylinder faster than water. Tests and research will need to be undertaken by those organisations with an interest in finding a solution. Blast containment by foam-filled structures is also a promising idea yet to be tested.

It is clear that we cannot let the current situation continue. London's economy and the safety of its people and its firefighters mean that we have to find a better way □

**Sir Ken Knight is the London fire commissioner**

# Cool it

Fire service practice for dealing with road incidents involving acetylene gas cylinders could be revised following a new study.

*FP&FEJ reports*

**A** PROJECT commissioned by the Highways Agency is exploring possible changes to fire and rescue service procedures for dealing with incidents on the road network that involve acetylene gas cylinders.

Research by BRE Fire and Security suggests it may be possible to relax the current practice of cooling acetylene cylinders for a period of 24 hours and setting up a 200m exclusion zone. The Highways Agency argues that this practice, when adopted by fire crews at road incidents, causes significant disruption, typically resulting in the closure of motorways and major trunk roads.

The study, which started in the summer and will continue with trials in 2007, is also examining whether 'quicker, less intrusive solutions' can be introduced for dealing with road incidents that involve acetylene cylinders, while maintaining the safety of the travelling public and attending firefighters. For example, it says the dynamic risk assessment process could be applied more widely at such incidents; and suggests that specialist fire service rapid response teams could be set up for dealing specifically with acetylene emergencies.

BRE's research is also looking at the wider use of cold-cutting equipment and remote controlled devices to inspect and neutralise cylinders; as well as whether acetylene gas usage could be reduced or phased out altogether in the medium or long term.

## Major congestion

According to the research, incidents involving acetylene gas cylinders – for example, fires or impact damage in vehicles, or in buildings near roads, that contain cylinders – are a 'unique and acute problem'. Such incidents, although fairly rare, result in major disruption and congestion, often leading to closures of roads or adjacent buildings or railway lines. They are also resource intensive for the emergency services.

Typically, these delays result from the need for attending fire and rescue crews to cool the cylinders for a period of 24 hours and set up a 200m exclusion zone around the incident. This practice is carried out because, unlike other hazardous gases, acetylene can decompose (and impact on heat) over an extended timescale. Industry guidance offers procedures under which the 24-hour cooling period may be reduced if the cylinder stabilises, but these procedures are not thought to be widely used.

The delays that acetylene incidents cause to the travelling public prompted the Traffic Incident Management Policy Team of the Highways Agency to commission BRE to undertake research on measures to tackle the problem.

The first part of what will be a three-phase project was completed in summer 2006. This involved a scoping study which reviewed current practice and considered various potential approaches to relax the 24-hour cooling period and the 200m exclusion zone, or to remove this practice altogether.

The results of this study were published in a report in August. They include:

- in the immediate term, the wider application of the dynamic risk assessment process (using existing or modified industry guidance) to reduce the 200m exclusion zone could be pursued
- there is a need to optimise and validate current practices (namely, the 24-hour cooling period, the 200m exclusion zone and the wetting test)
- in the medium term, it may be possible to reduce usage of acetylene by the application of the Regulatory Reform (Fire Safety) Order 2005
- in the very long term, it may be possible to consider reducing or phasing out acetylene usage by introducing alternative (safer) gases or electrical methods. Such a move would require industry and European cooperation and include the need to revise current European legislation governing the use of acetylene gas

The report also highlights possible ways to support current firefighting procedures for dealing with acetylene incidents, all of which need to be applied without endangering firefighters' lives. It says the most 'effective and immediate way forward' would be to use cold-cutting techniques (as used by bomb disposal teams and some fire and rescue services) to neutralise affected cylinders *in situ*. 'Robot "wheelbarrows" would need to be brought to the scene and used to open a vehicle, inspect the cylinders, and then cut the cylinders open. Blast containment methods need to be developed to support such a process.' The report adds that trials are needed to establish whether or not the remaining acetylene gas (in acetone) will evaporate naturally and over what timescale, or need to be flared off. In either case, such a method should cause least damage to the road surface.

In addition, the research says there should be further exploration of whether military equipment could be used at road incidents involving acetylene. It suggests that the Highways Agency hold discussions with the Department for Communities and Local Government, the fire and rescue service and the Ministry of Defence (MOD) to determine how aid from MOD could be deployed under the Military Aid to the Civil Community arrangements. 'Aid, technical, operational and financial, could be established to provide support to the fire service by MOD at short notice and at determined locations on the road network,' says the report.

Another suggestion is that, in the medium to long term, a civil rapid response team could be established for dealing with acetylene incidents. This specialist team could comprise firefighters with appropriate expertise and training. It could be a logical next step because some brigades are already experimenting with cold-cutting equipment and firefighting robots.

The second phase of the research project, which is due for completion by the end of 2006, involves a fundamental review of the treatment of acetylene cylinders involved in road traffic incidents. This review is considering legislative requirements relating to acetylene, the views of the fire service on a risk-based approach to incidents, the use of remote controlled devices, and a review of best practice in these areas.

**Fire service approach**

Central to this work is an examination of the approach used by the fire service when risk assessing acetylene incidents. This is considering what mitigating factors would be required, as well as what information would be needed, to enable fire officers at the scene to relax the 24-hour cooling period and the 200m exclusion zone.

BRE is conscious that stakeholders should be engaged in the project to assist with the adoption and buy-in of any actions or new procedures resulting from the findings. As a result, there have been meetings with stakeholders to seek their views on various issues, including:

- the need for up-to-date industry guidance
- should there be specialist teams of firefighters with appropriate expertise and training to react to such incidents?
- operational issues for firefighters
- if remote controlled equipment is introduced more widely, who should take ownership of it?
- training needs
- what future research is needed?
- could the UK adopt the Swedish approach of shooting acetylene cylinders using high-velocity bullets in order to ignite and burn off the contents and make the cylinders safe?
- wider safety issues

A third phase of the research project will be carried out next year and involve a series of trials of the approaches seen to have potential for the most immediate and effective response. BRE emphasises that 'options (such as cold-cutting, removal from site and remote detonation) should be developed in such a way that current requirements for a 24-hour cooling period and 200m exclusion zone are maintained throughout the removal/neutralising operation up until the hazard has been dealt with satisfactorily. This will include a cost-benefit analysis of such options that are developed.'

Although the principal focus of the project is on acetylene incidents on the road network, BRE says many of the procedures and techniques discussed or proposed in the research would be applicable to, and of benefit in, other incidents – for example, those involving other hazardous materials or products transported on roads; incidents involving liquefied petroleum gas or hydrogen fuels; and those involving acetylene and other hazardous materials in the built environment □

*The report on the first phase of the BRE research, Acetylene Gas – Its Use and Transportation. Phase 1 Report, is available from the Highways Agency website: [www.ha-research.gov.uk](http://www.ha-research.gov.uk).*