Gas explosion on an urban street
28 February 2008
Lyon (Rhône)
France

Pipeline / distribution
Natural gas
Explosion
Road works
Urban area
Victims
Property damages

THE FACILITIES INVOLVED

The Cours Lafayette is a busy retail thoroughfare in the city of Lyon, serving as a major arterial for the city's 3rd arrondissement and providing access to the Part-Dieu business district.

(left) Sketch of an arrondissement map for the City of Lyon; (right) close-up of the district where the accident occurred - Rights reserved

A natural gas distribution pipe made of polyethylene (service pressure: 4 bar, diameter: 63 mm, buried depth: 80 cm) ran parallel to the sidewalks next to buildings at addresses 115, 117 and 119 Cours Lafayette. An expansion chamber decompressed the gas from 4 bar to 21 mbar at the base of the building.

Building addresses 117 and 119 Cours Lafayette - Photograph taken in April 2012 - Source: BARPI

In 2003, this natural gas pipe was routed inside a larger (diameter: 150 mm) existing grey cast-iron pipeline as part of the program to phase out grey cast-iron pipes. The polyethylene pipe was therefore centred inside the cast-iron conduit (with a protective tube) using circular plastic parts called "centralizers". Nonetheless, the grey cast-iron tube avoided all connection junctions along the gas distribution line.

THE ACCIDENT, ITS TIMEFRAME, EFFECTS AND CONSEQUENCES

The accident:

A company specialised in replacing water intake connectors made of lead with polyethylene piping arrived at building address 119 Cours Lafayette around 8 am in response to a call by the Water Department. These works were being conducted as part of a project to replace 35,000 lead water pipe connections throughout the Lyon Metropolitan Area.

A crew performing works on the street detected a gas odour and notified emergency services around 11:30 that morning. A safety perimeter was set up at 11:46 am.

Around 12:15 pm, a gas explosion occurred at the level of 117 Cours Lafayette, causing the death of one fire-fighter and injuring 40 peoples, including 14 fire-fighters, 5 police officers and 2 gas technicians. In all, 1,000 people had to be evacuated in the vicinity of the explosion. A gas leak ignited shortly after the explosion in front of the building at 119 Cours Lafayette. The "code red" emergency plan was activated within the Rhône Department in order to deploy emergency services, resulting in the mobilization of some 100 fire-fighters and over 300 police officers.

Ignited gas leak following the explosion - Source: DREAL (Regional Environmental Agency) Rhône-Alpes

Emergency services entered the neighbouring buildings as electricity outages had left several hundred local residents stranded in their building elevators. Phone communication lines and networks were also cut.

The section of the distribution network involved in the accident was isolated and drained (at zero pressure) at 2:40 pm.

France's Minister of the Interior visited the explosion site that afternoon and expressed her regret that "all safety procedures had not been adequately taken into account" during works on the pipe and moreover indicated her desire to "reinforce safety conditions in concert with elected officials for pipe installation work" given that other accidents of this type had already occurred the previous autumn (Bondy - ARIA 33784, Noisy-le-Sec - ARIA 34042).

Consequences of this accident:

Human toll

The deceased fire-fighter was moving through the basement levels of a building in an attempt to determine the extent of the gas leak when he got trapped by the explosion.

Among the 40 injured, a technician with the gas department was in a critical condition, while several others were transported to a nearby pharmacy at 125 Cours Lafayette after sustaining only scratches.

Many residents needed to be rehoused. The count of victims affected directly or indirectly by the event rose to over 250.

Economic impacts

Property damage to buildings and cars parked in front of 117 and 119 Cours Lafayette was considerable and even extended to the rue Moncey cross street (see map on page 1 and accompanying photographs).

Property damage - Source: DREAL (Regional Environmental Agency) Rhône-Alpes

No estimation of the amount of losses has ever been provided. In all likelihood, due to the damage caused to buildings, cars and operating losses incurred by district retailers, this cost would have risen into the millions of euros.

The European scale of industrial accidents:

By applying the rating rules applicable to the 18 parameters of the scale officially adopted in February 1994 by the Member States' Competent Authority Committee for implementing the "SEVESO" Directive on handling hazardous substances and in light of information available, this accident can be characterised by the four following indices:

The parameters used in these indices and their corresponding rating protocol are available at the following Website: http://www.aria.developpement-durable.gouv.fr.

The "Dangerous materials released" index was rated a 1 due to the broken window panes in the vicinity of the explosion (blast effect distance less than 300 m - parameter Q2).

The "Human and social consequences" index scored a 6 for the large number of local residents (some 20 households) still unable in 2012 to return to their residences, as indicated in the photograph on page 6 (parameter H7).

The "Economic consequences" index was assigned a 4 as a result of the estimated several million euros in damage to cars, buildings and shops near the accident site (parameter €17).

No environmental impact was reported, which explains the 0 rating given to the "environmental consequences" index.

THE ORIGIN, CAUSES AND CIRCUMSTANCES SURROUNDING THIS ACCIDENT

Origin of the explosion:

The accident occurred right at the time the public works contractor was extracting a lead water pipe. Natural gas leaked out at the level of an expansion chamber, as evidenced by finding the chamber lid on the Cours Lafayette sidewalk. The gas then spread into basements and ground floors of the buildings at addresses 117 and 119. Gas ignition due to an undetermined source then caused the explosion.

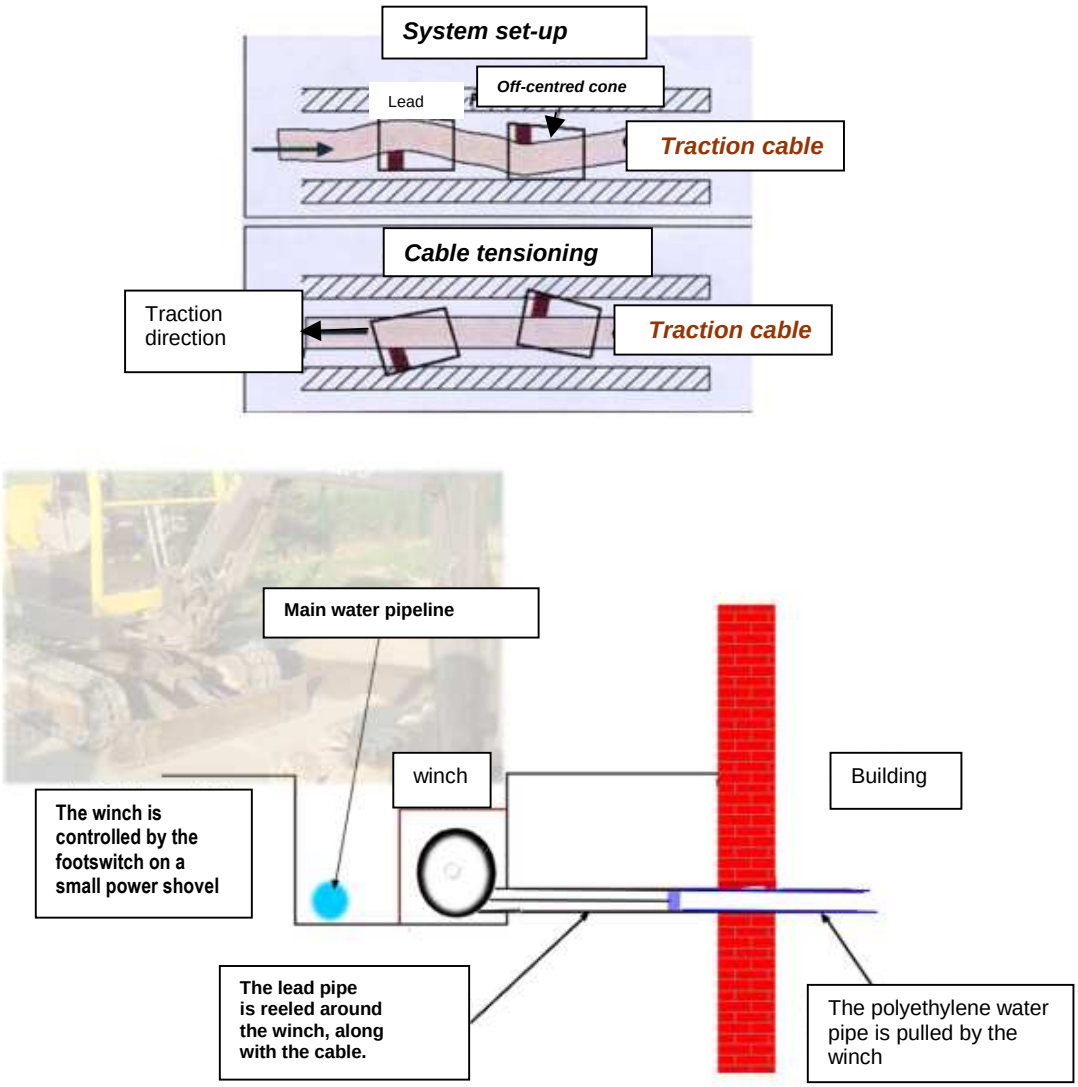
Circumstances surrounding the event:

In order to extract the lead pipe, the contractor proceeded by:

- excavating a shaft at the spot where the lead pipe was hooked up to the main water intake line;
- cutting lead connection pipes at the level of the shaft and inside the building being supplied;
- sliding a metal cable into the lead pipe until it reached the interior of the building;
- fastening a cable clamp at the end where the polyethylene pipe (designed to replace the lead pipe) was attached;

- installing a winch at the bottom of the shaft to draw the metal cable and then drag with it both the lead and polyethylene pipes.

This technique followed a patented procedure used thousands of times over many years on other projects.

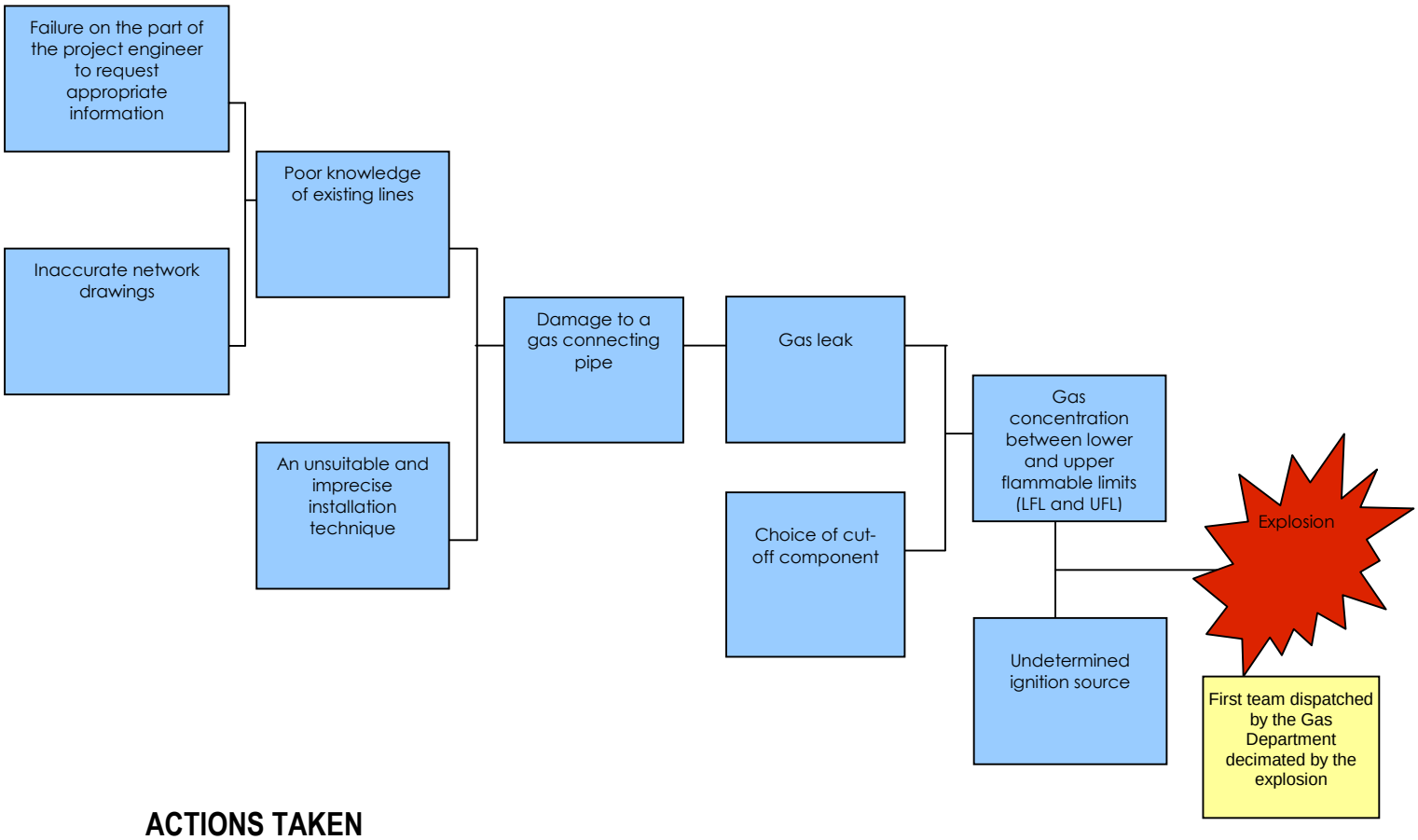


Schematic diagrams of the contractor's method - All rights reserved

Causes:

Both judicial and administrative investigations were undertaken following the accident.

Without the benefit of conclusions from ongoing judicial action, the gas explosion could be schematically explained as follows:



ACTIONS TAKEN

Subsequent judicial action:

Charges of homicide and involuntary injury as well as property destruction by explosive substance were brought against unknown perpetrators following the accident. The trial generated considerable testimony from the various parties involved: water and gas departments, road works contractors.

The judicial enquiry was concluded on 6th January 2010. Several indictments were handed down in relation to this case: the gas department, blamed for a delay in closing the valves on the day of the accident; the public works contractor; the water department, for having commissioned the works; and another contractor, who had performed a job in this sector in 2003.

In a committal for trial to appear before a criminal court dated 24th November 2011, the magistrate noted that responsibility for the explosion lay with many parties. The tragic accident could not be blamed on the action of a single company. The combined negligence, imprudent conduct and noncompliance with regulatory restrictions led to the gas leak and the eventual explosion. Each company would be judged as a corporate entity and represented by its managing director.

The trial has been scheduled for 27th January through 14th February 2014.

Formation of a monitoring committee for victims:

As a first for France, a monitoring committee was set up to provide early compensation to property damage victims; this effort took place in February 2009 at the behest of the insurance companies covering liable parties, thus giving rise to an "early compensation agreement". Beyond 2 years, the property insurers (covering apartment buildings) and homeowners' insurers were no longer reimbursing relocation or furniture storage expenses.

Building renovations:

As of April 2012, the building at 128 Cours Lafayette (opposite no. 119) was still undergoing rehabilitation and remained unoccupied.

128 Cours Lafayette - photograph taken in April 2012 - Source: BARPI

Subsequent administrative action:

While awaiting findings from the judicial investigation, all road work involving trenchless installations to replace lead pipes or horizontal drilling underneath the roadway adjacent to natural gas distribution lines was strictly prohibited by Prefectural order dated 7th March 2008.

This order was repealed by a superseding Prefectural order issued on 12th January 2009 subsequent to publication of a Ministerial decree dated 22nd December 2008 relative to trenchless installation works on city streets.

Regulatory modifications

An investigation report released in February 2008 by the Inspectorate for Defence and Civil Security, conducted after the accident in Noisy-le-Sec (ARIA 34042), listed some 20 proposals aimed at limiting the occurrence of such accidents:

- proposals of an administrative nature (single computerized service to streamline regulatory procedures prior to undertaking works, improved information transmission among actors);
- preventive measures (periodic monitoring of technicians, involvement of property owner with the greatest amount of oversight, enhanced mapping information);
- instructions (expanded pool of experience feedback on projects, better informed and trained subcontractors);
- operating guidelines (use of appropriately-designed vehicles).

This report also highlighted that many uncertainties remained throughout the utility networks, while recognising that despite the existence of written procedures, deficiencies were being introduced during implementation.

Moreover, the profession noted for the record that some market trends resulted in greater risks of accidents:

- a continuous rise in the volume of urban works;
- increasing clutter found in all types of underground utilities: electricity, gas, water, telecommunications
- ageing of network infrastructure.

These various observations provided the impetus for a major action plan aimed at preventing utility network damage and based on overhauling regulations applicable to works carried out adjacent to built structures. **A single computerized service was set up to catalogue all utility lines in place throughout France - accessible at the Web address:** www.reseaux-et-canalisations.gouv.fr

Emergency response

The supervision of emergency services requires effective coordination among all response departments (police, fire-fighters, facility operators). The key components herein include: activating the emergency plan when victims are reported, setting up a joint control station, and expanding the safety perimeter. A reinforced gas handling procedure was also adopted, tested and enacted among all fire protection and emergency agencies on 1st July 2011.

Depending on the event's potential impacts (ignited leak capable of causing an explosion, as was the case in the Sedan accident - ARIA 39091), such gas handling procedures were gradually extended in 2013 to encompass gas cabinet fires.

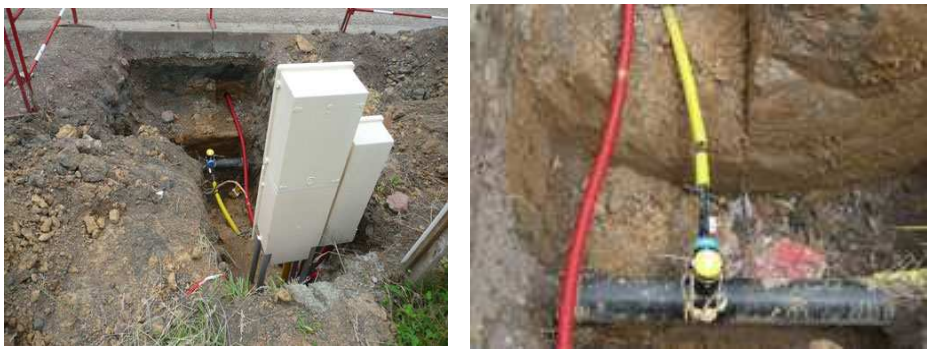
Response protocols and experience feedback stemming from application of these gas procedures are moreover discussed in public memoranda available for downloading from the following Website:

http://www.interieur.gouv.fr/Le-ministere/La-Securite-civile/Documentation-technique/Doctrines-et-techniques-professionnelles/Notes-operationnelles

LESSONS LEARNT

Several lessons can be drawn from the Cours Lafayette explosion:

- The choice of method employed within the scope of this type of road works (whether cutting a trench or not) should be the topic of a risk analysis that takes into account the condition of utility networks at the time of conducting such works, while ensuring that surveying phases are never overlooked (use of boreholes as needed);
- The procedure of Information Request / Notice to Commence Works needs to be improved in order to both furnish public works contractors with reliable information on the location of utility lines and promote exchanges between the project engineer, utility network managers and public works contractors;
- Drawings must be as accurate as possible and provide the status of utility lines carrying hazardous fluids (e.g. gas, overheated water) as well as all other networks (telecommunications, electricity, wastewater, etc.);
- In the event of an accident, it must be possible to identify and close very quickly all cut-off components of a distribution network carrying hazardous fluids;
- Connection pipes between the gas distribution network and residential pipes must be better protected in light of the large number of worksites in their vicinity and their vulnerability when subjected to a shock.



Photographs of a gas connection pipe - the distribution pipe is shown in black (the connection is visible by a yellow cap), and the gas pipe extending from a residence's gas cabinet is in yellow - All rights reserved.