



Gas distribution pipelines



@ Gas leak in a pipeline

ARIA 34042 - 22/12/2007 - 93 - NOISY-LE-SEC

35.22 – Pipeline distribution of gas fuels

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Gas leaked from a pipeline below a pavement at around 9.00 am which was followed by two explosions at around 9.45. A 5-storey residential building caught fire and collapsed partially. Approximately 100 people were evacuated. Gas supply to 200 customers was cut-off. The fire was extinguished by 176 fire-fighters and 51 fire-engines. The fire-fighters also carried out the clearing and research operations. The rescue operations ended on 23/12 at around midday. Eight people sustained injuries and 36 flats were destroyed. Boring operations aimed at soil testing in the residential area may have possibly triggered the accident. An enquiry was conducted to analyse the malfunctioning observed and suggest solutions.

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Gas distribution pipelines

Each year, over 6,000 cases of damage to gas distribution pipelines following leaks are recorded in France due to works in the vicinity of the distribution networks. The years 2007 and 2008 were particularly grim with four successive serious accidents in Niort (ARIA [33803](#)), Bondy (ARIA [33784](#)), Noisy-le-sec (ARIA [34042](#)) and Lyon (ARIA [34280](#)).

Even though road works in the vicinity of the distribution networks are the main cause of the accidents, other circumstances have also led to accidents: melting of polyethylene pipelines in a fire causing the transported gas to be released (ARIA 18653) or damage to a pipeline during an electrical short circuit (29484) for instance. Several cases of gas leak from sectional valves (ARIA 27888, 27887 28698, 30885), valves (ARIA 30028) or insulating joints (ARIA 35290, 35744) are also recorded.

An investigation report drafted by the French civil defence and safety authorities in February 2008 following the Bondy (ARIA 33784) and Noisy-le-sec (ARIA 34042) accidents took stock of the situation and suggested areas of improvement. The French Ministry of Sustainable Development also set up national work groups in charge of improving existing regulations on works near gas distribution networks (decree no. 91-1147 dated 14 October 1991).

Some of the accidents occurred in the vicinity of industrial facilities (ARIA 28360, [29900](#), 35790) or in public places (railway stations, petrol stations) or sometimes involved significant quantities of hazardous material (ARIA 27455, 28148).

Construction sites must be managed in a stringent and safe way: attacks on structures by public works equipment (power shovels, augers, non-directional drilling equipment such as boring tools, etc.) are the most often seen (ARIA n° [33784](#), [33803](#), [34802](#)), but other cases are also observed: truck spilling its contents in a pipe trench (ARIA 1219) or a basement wall collapsing under the weight of a crane (ARIA 3423).

Some accidents illustrate the lack of reliability of the information provided and absence or inadequate onsite inspection by technicians working on gas distribution networks. Inaccurate and even wrong gas distribution network maps are regularly reported (ARIA [33803](#), [34802](#)).

Several initiatives as part of a preventive strategy must be taken to reduce the occurrence of accidents. This mainly depends on an analysis phase before starting works, risk prevention during the works, reducing effects of accidents, protection of people and property, appropriate coordination among emergency services, as well as optimal management of the post-accident phase.

Moreover, it is also recommended to bear in mind the condition of the gas distribution networks especially when dealing with old pipelines. Accidents have made reference to the corrosion of steel tubes (ARIA [1092](#)) or equipment inherent to piping such as lamellar graphite cast iron also called "grey cast iron" (ARIA [21551](#), [28855](#)). Grey cast iron is the cause of pipeline rupture in several serious accidents including the explosion in Mulhouse on 26 December 2004 (ARIA [28855](#)) resulting in several deaths. Grey cast iron has also resulted in the decree dated 1st December 2005 on prohibiting exploring of grey cast iron gas distribution pipelines. The decree has led to their complete disappearance.

The absence of a formal Start of Works Notification (DICT) by the undertaking company and even more frequently no formal Request for Information (DR) by the contracting authority or presence of wrong information (ARIA [21216](#), 18776, [26397](#), [34802](#)), or inaccurate gas distribution network maps (ARIA [33803](#), [34802](#)), poor management of construction site and inadequate training of staff speak in favour for better risk prevention at source.

To keep the effects of a gas leak to a strict minimum, rapidly isolating a section (ARIA n°35181), even cutting off power supply (gas, electricity) in the district to prevent the risk of creation and explosion of gas accumulation, implementing an initial safety perimeter and plugging the pipeline (ARIA 21216) require efficient organisation of the departments and bodies involved as well as acquisition of safety reflexes by the staff concerned (evacuating the premises calmly, promptly informing the fire department upon detection of a gas smell). As part of the action plan driven by the French Ministry of Home Affairs by the French Sustainable Development Ministry, a procedure called "reinforced gas" has been set to provide a pro-reactive response in managing accidents when sensitivity criteria have been met (and in particular when the gas leak is likely to spread to residences). This procedure has currently been tested in several regions in France and guarantees availability of significant resources provided by emergency services and the gas distribution network operator to create a safety perimeter, evacuate the people present at the earliest and manage the leak as soon as possible.

Management of emergency operations deserves optimal coordination between all involved departments (police, fire-fighters, etc.) and operators: triggering an emergency plan especially in the event of a casualty (ARIA [33784](#)), setting up a centralised control station for all departments, adjusting the safety perimeter and managing communication are all vital elements.

The accidents whose references are not underlined may be consulted at:
www.aria.developpement-durable.gouv.fr

  **ARIA 1092 - 25/02/1989 - 43 - VALS-PRES-LE-PUY**
 35.22 – *Supply of gas fuels through pipelines*
 A leak in a water network body end corroded a gas pipeline in the city. The gas leaked and exploded destroying a two-storey building and causing damage to two other. Three persons including one fire-fighter sustained injuries.



  **ARIA 21216 - 08/10/2001 - 57 - MARANGE-SILVANGE**
 35.22 - *Supply of gas fuels through pipelines*
 Gas leaked from a 32 mm diameter polyethylene pipeline at a pressure of 3.9 bars and connected to a steel tube with a 100 mm diameter. While excavating the pavement on the public road, the earthmoving machinery lifted and then folded the steel pipe on causing the polyethylene tube to be ripped out. The company had not made a request for the DICT (formal Start of Works Notification). The company was a working in the capacity of a sub-contractor for another company. The technical gas department arrived onsite. The emergency services established a safety perimeter. Road traffic was prohibited in the district. Electricity and gas supply were cut off. Ten detached homes were evacuated and the families moved to a community hall during the time taken to clog the leak. The leak was partially sealed 2 hours and 20 minutes after the alert was sounded and fully sealed after 6 hours and 25 minutes. The fire-fighters used nozzles (including 2 that set up a fan-shaped water curtain) to set up water curtains to disperse the gas cloud. The technical gas department demanded compensation from the company. Since accidents had already occurred in the past, the company was also asked to train its employees and analyse the various accidents occurred.



  **ARIA 21551 - 04/12/1999 - 21 - DIJON**
 35.22 - *Supply of gas fuels through pipelines*
 Shortly before midnight, a violent deflagration in a five-storey building destroyed the entire stairwell of a building that collapsed forming a 900 m³ heap of gravel and dust. The red alert was sounded. Significant human and material resources were deployed to clean up the wreckage and attend to the victims. Eleven dead bodies and 3 injured people including one seriously injured child were extracted from the debris. A legal enquiry and expertises were carried out to determine the precise cause and circumstances of the accident.



According to the gas department in question, a first expertise report claimed that the rupture of a 100 mm grey cast iron pipeline at 3.5 m from the building that was commissioned since 1955 led to the explosion. This report also stated that equipment was cased during operations carried out in the mid eighties upon the request of the members of the co-ownership. Two different materials used to lay the piping may have weakened it over the years causing it to rupture. The resistance of the pipeline to withstand external stress was weakened by the grey cast iron widely used from 1940 to 1970 (comprising 1/3rd of the network according to the operator). The use of grey cast iron in new pipes has been discarded for over 20 years and has been mainly replaced by polyethylene since 1980. As part of the nation programme on modernising its gas supply networks, the gas department had moreover planned to gradually replace all existing grey cast iron pipes over several years.

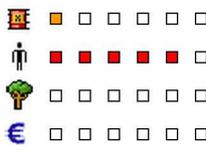
However, given that the gas department was aware of the fragile and dangerous nature of grey cast iron and it failed to further its objective of replacing all pipelines despite sufficient financial resources, the French Criminal Court sentenced the gas department to pay a fine of 204,500 euros for involuntary manslaughter and injury on 23 March 2006. The ruling was upheld on the 21 December 2006 by the Dijon Court of Appeal that based its verdict on the facts taken into account for the initial ruling (non-renewal of the pipeline, insufficient odour of gas, mistake in the map.)

  **ARIA 28855 - 26/12/2004 - 68 - MULHOUSE**
 35.22 - *Supply of gas fuels through pipelines*
 A four-storey building was destroyed in a violent explosion that took place around 5.00 pm killing 17 people and causing light injuries to 15. The explosion also damaged two linked social dwellings (comprising 10 flats each) leading to the partial collapse of one of the buildings in the evening. Around 100 fire-fighters backed by rescue and clean up units were called in: dog team, heavy equipment such as backhoe loader, etc. A safety perimeter was set up. Rescue operations were impeded by the suspected presence of accumulated residual gas: fire nozzles were installed as a precautionary measure to counter the lingering risk. During the phase of securing the premises, 260 homes were deprived of gas. Operations continued all night until a part of the following day. Homeless families were offered alternative housing. The accident caused an emotional stir amongst the masses and the mayor was concerned over the presence of similar pipelines. Administrative and legal enquiries were commissioned to determine the causes of the explosion. The gas department mentioned that the inspection of the network on 10/12/2004 after five days following a tremor revealed no malfunctioning. Furthermore, no emergency call was made on the day of the accident. The legal expertise report was presented to the families of the victims on December 2005 by the public prosecutor. The report stated the instantaneous rupture of a grey cast iron pipeline laid in 1957 at a little over 5 m from the building causing a significant gas leak. The gas company was placed under judicial investigation in the capacity of a legal person. A programme to replace grey cast iron pipes that was launched in the 80s was still in place. The French Ministry of Industry its completion for end 2007 (2,000 km of such pipelines, i.e. 1.2% of the supply network must be replaced within the deadline), as well as treatment of sensitive areas for end 2006. The gas company set up an audit mission undertaking three annual inspections of the pipeline as opposed to one in the past. Furthermore, a compensation fund for the victims was also set up.



  **ARIA 29900 - 26/05/2005 - 73 - HERMILLON**
 35.22 - *Supply of gas fuels through pipelines*
 Around 11.00 am, an earthmoving machine ripped out a low pressure pipeline (diameter = 40 mm) in the public road of a commercial zone causing a gas leak. A 60 m safety perimeter was set up and 54 persons evacuated. Gas indicator measurements revealed a danger zone at 2 m from the leak. The technical team from the gas department cut off supply in the sector, thus stopping the leak. The shops reopened around 3.00 pm. Operations in a foundry supplied by the gas network were disturbed during repair: two furnaces were temporarily stopped.

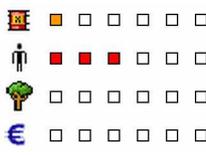


 **ARIA 33784 - 30/10/2007 - 93 - BONDY**

35.22 - Supply of gas fuels through pipelines

At 2.00 pm, an explosion resulting from the accidental puncturing of a gas pipeline (service pressure: 4 bars, commissioned on March 2007) was followed by a fire during road works. The red alert was triggered at 2.19 pm and around 251 fire-fighters along with 68 fire engines were called in. A safety perimeter was set up and then widened given the new developments and the risk of a second explosion.

At 4.30 pm, the road works team crushed the 63 mm polyethylene pipeline to stop the gas flow. The emergency services then put out the fire. The provisional casualty toll of the accident stood at one death, 63 injured including 10 cases of serious burns (4 with very poor vital prognosis). Two residential buildings including one café-restaurant on the ground floor were damaged. Legal proceedings had been instituted on 9 November for involuntary manslaughter and injury, damage to property following breach of duty of care and safety requirement.

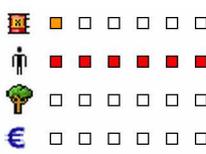
 **ARIA 33803 - 05/11/2007 - 79 - NIORT**

35.22 - Supply of gas fuels through pipelines

At 6.00 pm, a power shovel operating in a public road damaged a gas distribution pipeline. The fire-fighters were informed and were onsite along with the gas company. During exploration, an explosion followed by a fire occurred at the level of a detached house located near the construction site.

The detached house was completely destroyed and eight people sustained injuries including 4 residents and one fire-fighter who were seriously injured.

The police set up a 50 m safety perimeter. The leak was stopped at 6.20 pm. The fire-fighters installed two variable flow nozzles and extinguished the fire at 11.00 pm. Eighty houses were deprived of gas for 3 hours. According to the press, none of the maps showed the presence of the pipeline.

 **ARIA 34280 - 28/02/2008 - 69 - LYON**

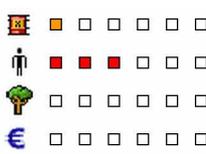
35.22 - Supply of gas fuels through pipelines

A gas leak in the city centre at around 11.30 am was reported in a public construction site on a public road. The rescue services set up the safety perimeter and carried out an exploration operation. An explosion followed 45 min later and damaged several buildings. The fire engulfed the buildings near the site of explosion before spreading to the other buildings as well. The rescue operation required 180 fire-fighters and 300 policemen. The gas supply to the source of the leak on fire was cut off at 2.15 pm

Between 500 and 1000 people were evacuated including children, staff of a school and day care nursery. 38 residents were temporarily accommodated in a nearby gymnasium. A young fire-fighter evacuating the last occupants of a building lost his life and about forty cases of injuries were reported. A legal and administrative enquiry was carried out to investigate the circumstances and causes of the tragedy. On 30/06, as a precautionary measure, 7 people were evacuated from a building that risked collapse located in front of the site of explosion.

An investigation report prepared after the Noisy-le-Sec (ARIA 34042) accident put forth around 20 proposals aimed at preventing such accidents. The suggested measures included administrative (single computerise contact point to facilitate regulatory formalities before works, better information sharing among the players involved, etc.), preventive (regular surveillance of technicians, involvement of the contracting authority as early as possible, improvement of information provided on maps, etc.), pedagogical (enhanced feedback on construction sites, raising awareness of players involved through training, etc.) and operational (avoiding the use of oversized earthmoving equipment to perform operations, etc.) ones as well.

This report underlines the number of uncertainties on networks while admitting that errors occur at the implementation stage even though procedures are drafted. Several think tanks have been set up to study these recommendations and draft concrete proposals.

 **ARIA 34802 - 01/07/2008 - 39 - SAINT-LAURENT-EN-GRANDVAUX**

35.22 - Supply of gas fuels through pipelines

In an optical fibre laying site, a toothed trenching machine severed and ripped out a natural gas distribution pipeline (diameter 125 mm, pressure 4 bar). The employees switched off the engine of their vehicle. The gas department was informed and arrived onsite at 3.26 pm. It closed a valve upstream after spending 50 min trying to cut off the pipeline's gas supply. Repair operations started at 6.30 pm and the gas supply was restored as of 9.00 pm to some customers.

The inspection authorities for classified facilities arrived onsite and the operator had submitted the formal Start of Works Notification and a yellow warning fence was found buried 0.6 to 1 m deep in the debris on the pipeline.

Further to this accident, the report of the inspection authorities for classified facilities stated that it was not easy to read the maps provided with the formal Start of Works Notification (DICT). The map provided by the technical team of the gas departments in two parts specifies that the pipeline crosses the RN5 at the Y junction of the road. The two parts of each of the maps were accurate but the assembly scales were not properly adapted. The bifurcations of the successive roads led to an error in precisely locating the position of the pipeline.

The accident had significant social consequences: road traffic was stopped and 320 residences deprived of gas.