Explosion
Fire
Leak
Filling centre
Butane
Utility shafts
Hose
Victims

Explosion in an LPG filling centre

December 22, 1975

Mâcon [Saône et Loire]

France

THE INSTALLATIONS IN QUESTION

The site :

The site includes an LPG storage facility and a filling centre.

According to how the property is configured, the electrical installation is located in the maintenance workshop which also contains the air compressors and is located approximately 70 m from the filling building. Connections with the facility are provided via an underground trench covered by concrete slabs.

The filling hall is equipped with a product recovery device in the event of overfilling of cylinders or valve change and comprises a 1 m³ tank maintained in a vacuum by LPG compressors in which flows the product through a steel pipe that ends in a hose. The hose is fitted with a tapered plug valve.

THE ACCIDENT, ITS BEHAVIOUR, EFFECTS AND CONSEQUENCES

The accident :

According to the operator, on the Friday prior to the accident, the hose ruptured and the butane in the tank leaked out via the crack over the weekend. The gas spread across the ground and, considering the nearly freezing temperature, the gas remained in liquid phase and made its way to trench and into the electric facility. On Monday morning, when the centre was opened up, the actuation of the contactors triggered the explosion. The fire that followed was rapidly brought under control with a dry chemical extinguisher.

The consequences :

Of the 15 people inside the workshop at the time of the accident, 8 are slightly injured including 2 who where hospitalised for several days. The property damage are limited to the maintenance facility : electrical switchboard destroyed, building walls deformed, roofing blown out. Approximately 1 m³ of butane was released.

European scale of industrial accidents

By applying the rating rules of the 18 parameters of the scale made official in February 1994 by the Committee of Competent Authorities of the Member States which oversees the application of the 'SEVESO' directive, the accident can be characterised by the following 4 indices, based on the information available.

The parameters that comprise these indices and the corresponding rating method are available at the following address : http://www.aria.ecologie.gouv.fr.

Level 2 for the dangerous materials released parameter shows the leak of about 500 kg of butane.

Level 2 attributed to the human consequences shows the casualties resulting from the accident (8 persons injured including 2 people hospitalised for a few days).

ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

The accident is attributed to the propagation of LPG vapours via electrical cable trenches to the maintenance facility located a distance away from the workshops where the LPG is shored or handled.

LESSONS LEARNED

Following the accident, the operator propose to isolate both ends of culverts or trenches containing electrical conduit, using plaster plugs for example, to avoid the propagation of gas to facilities which could trigger ignition.

Generally speaking, the use of plugs at the ends of devices used to house electric cables or utility lines help curtail the spread of gas from a room or building to the other.

Other accidents at LPG depots of the type having led to the same problem :

Hauconcourt (Moselle), 11/18/2003 : see summary No. 25923 in the appendix.

Other accidents in other activities having resulted in a similar problem :

La Guérinière (Vendée), 11/29/1993 : see summary No. 4981 in the appendix.

Charolles (Saône et Loire), 02/09/1994 : see summary No. 4203 in the appendix.

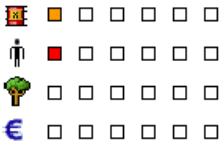
Montmirail (Marne), 12/04/1997 : see summary No. 12091 in the appendix.

Dieulouard (Meurthe et Moselle), 04/08/2003 : see summary No. 24411 in the appendix.

Aubigny sur Nère (Cher), 12/10/2004 : see summary No. 28734 in the appendix.

APPENDIX:

Other accidents at LPG depots of the type having led to the same problem:

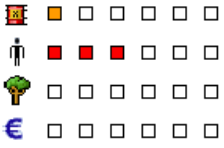


No. 25923 - 11/18/2003 - Moselle - HAUCONCOURT

40.2 - Production and distribution of gas fuels

In an LPG filling centre, at around 2.15 pm, a site employee was drilling a hole in the "PLC" technical facility located in a zone not considered to be a gas hazard: The technical facility serves the administrative building (among others) by 3 electrical conduits which are joined together routed into the crawl space. While drilling the hole, a flash erupts and burns the employee who then actuates the nearest emergency stop. The device secured the site (installations are shut down and sensitive areas are sprayed down). The employees were able to bring the outbreak of fire under control fairly rapidly. One employee raised a floor board in the facility, then another, before being burned by a second flash which was also rapidly brought under control with dry chemical (powder) fire extinguishers. The 2 employees were hospitalised (burns to the face and hands...). The facility was damaged and the centre's activity was momentarily interrupted. Following verifications, the safety installations resumed normal operations around 7 pm. The accident was attributed to a leak on a propane line supplying the administrative building's heating boiler. The cover piping (dia.: 22 mm) is routed overhead from the storage tank (11.6 m³, for administrative building heating + filling hall, supplied directly from the filling hall) then buried (dia.: 14 mm) and then, via the crawl space, enters the boiler room: a screw-type connection in the buried section ruptured, causing a leak and the accumulation of gas in the ground, along the conduit and into the crawl space. From there, it continued into the [unblocked] electrical conduits to the PLC facility. The drill created the ignition point of the 1st flash. In the second case, a hot spot had remained and when the plates were raised, the resulting influx of air caused the remaining gas to reignite. On the Inspectorate's proposal, a formal prefectoral notice requested the periodic verification of the pipes, monitoring of resistance and seal, and the updating of the internal contingency plan. The operator has considered implementing the following measures at the site: installation of a 1.7 m³ tank dedicated to the administrative building's heating system, and heating tanks being filled by truck. At all of the company's sites: the inventory of the buried pipes followed by a program to route them overhead, and operations to plug electrical supply conduits outside the zone.

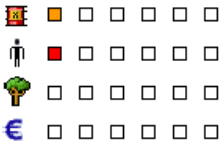
Other accidents in other activities having resulted in a similar problem



No. 4981 - 11/29/1993 – Vendée - LA GUERINIERE

52.1 – Retailing in a combination store

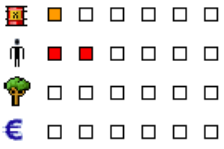
An explosion and fire occurred in a supermarket service station when a gasoline truck was unloading. The cashier at the station initiated the explosion by actuating an electrical switch in her kiosk. The flammable cloud came from a dipstick opening that had been left open. The accumulating gas entered the kiosk via an unsealed electrical cable conduit. The fire injured 2 people: the fire burned the cashier on the hands and face, and a customer near the kiosk. The relatively recent installation (1987 / 1990) was not in compliance with regulations: lack of a hermetic gauge cap, location of the gas depot, etc.



No. 4203 - 02/09/1994 – Saône et Loire - CHAROLLES

52.1 – Retailing in a combination store

A driver unloaded his tanker truck containing 7,000 litres of lead-free premium gasoline, 9,000 litres of premium and 14,000 litres of diesel fuel into the tanks of a service station. Two of the tanks were open and the hydrocarbon fumes, routed by an electrical conduit, spread into the kiosk where a cashier was working. The gases were not evacuated by ventilation outlets as they had been covered with cardboard. A spark was created when the cashier switched off the heater, which ignited the air/vapour mixture. She was burned on the face and hands. Following the explosion, the driver was able to bring the resulting fire under control with a fire extinguisher.



No. 12091 - 12/04/1997 – Marne - MONTMIRAIL

50.5 – Fuel retailing business

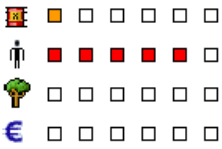
While a tanker truck was unloading diesel fuel and gasoline into the tanks at a service station, the fuel vapours spread to the cashier's kiosk via the electrical conduits and exploded upon contact with an electric radiator. The kiosk was destroyed. The kiosk's ventilation had been blocked. An outbreak of fire was put down with a fire extinguisher. The cashier was burned to the 2nd degree. A customer was slightly injured by flying glass. The company plugged the conduit openings and improved the ventilation in the new kiosk. The feedback was distributed to all of the group's service stations.

No. 24411 - 04/08/2003 –Meurthe et Moselle - DIEULOUARD

27.1 - Iron and steel industry

A propane explosion occurred in the ancillary installations of a plant specialised in the preparation of iron ore for the steel industry. In order to make the conglomerate used in blast furnaces, the plant has iron ore delivered by train car which pass through a heated corridor which thaws out the hatches before being unloaded. The burners in this corridor are supplied by propane, which is stored in two tanks with a capacity of 10 m³ each. The propane circulates in overhead pipes to the vaporiser (on site), then in gaseous form via an underground pipe to the heating tunnel. This tunnel is located on a siding that runs parallel to the Nancy-Metz rail line, on the outside of the site, as does part of the propane pipe that supplies it. The RN 57 national highway is located between the tracks and the site. The Moselle canal is located on the other side of

the tracks. A leak on the buried portion of the gas line propagated into an underground concrete structure used to route rain water drainage pipes to the Moselle canal, and industrial water pumping lines. The gas presumably made its way into this structure then to the 50 m² technical facility located on the site which contains electrical installations and the pumping station. A spark created when one of the pumps was started may have initiated the explosion of the accumulated propane. An inquiry was conducted to determine the exact origin of the accident. The explosion destroyed 90% of the technical facility and threw debris onto the RN 57, located roughly 10 meters away. The emergency services established a security perimeter of one hundred meters and installed a small monitor as a protective measure. Traffic on the national highway and rail traffic on the Nancy-Metz line were suspended. The plant temporarily suspended its activities.



No. 28734 - 12/10/2004 - Cher - AUBIGNY-SUR-NERE

52.1 – Retailing in a combination store

In the early afternoon, a explosion at a car wash killed 2 people washing their car. The emergency services established a security perimeter and the service station at a shopping centre located thirty meters away was closed temporarily. According to initial reports, the explosion occurred in the station's technical facility located between 2 washing areas, destroying the building and throwing cement blocks to distances up to 5 - 6 meters. The facility which houses electrically-supplied (not gas) equipment is located near 2 underground fuel tanks supplying the pumps of the neighbouring service station. The car wash is located in a area that was previously occupied by this service station: in particular, the former fuel distribution island was located to the right of the car wash's current technical facility. The closest tank is 2 m from the facility. At the service station, the initial findings showed that the hermetic caps used to plug the gauging openings of the buried tanks were not in place. As the site is configured, these openings arrive in a manhole, which is itself closed by a cover. Pipes which were no longer used by the service station although which previously served its former distribution island also arrive in this manhole. Inasmuch as the fuel tanks were filled 1 hour prior to the accident, one of the possible theories would be that gas fumes travelled through the open orifices and the manhole, in the abandoned pipes making its way to the technical facility. There, they were able to accumulate (a congested and narrow place) and cause the violent explosion that occurred, provided that there is a connection between the abandoned conduit and the technical compartment. An inquiry was conducted.