

Explosion of a tank undergoing transfer in an oil product depot

15 October 1993

Cusset - [Allier]

France

Explosion
Fire
Oil depot
Domestic fuel oil
Tanker truck
Transfer
(loading/unloading)
Cargo hose
Victims
Biodegradation

FACILITIES CONCERNED

Since 1927, the 2,700 m² oil depot has been located in an industrial zone less than 500 m from the Vichy – Cusset metropolitan area and is close to another hydrocarbon depot with a capacity of 35,000 m³. It is operated by a firm certified by an oil company.

The firm has undergone several modifications ever since it was set up. The facilities include:

- three 70 m³ aboveground tanks, i.e. total capacity 210 m³
- three 30 m³ underground tanks, i.e. total capacity 90 m³
- a tanker truck unloading area situated below the depot
- a tanker truck filling station comprising two loading arms (maximum flow of 2 X 30 m³/h) with three pump units. The entire structure is covered by a metal canopy standing against a building with a metal siding. The abandoned building houses a removable 1,000 litre tank that was empty at the time of the accident
- a shed stocking 8 to 10 tonnes of anthracite
- a railway junction

The floor of the oil depot slopes towards the doorway. The transfer zone that is not separated from the tanker trucks is not equipped with a drip recovery device and the ground is superficially soaked with hydrocarbons.

Administrative situation:

The domestic fuel oil (stored in 210 m³ overground and 90 m³ underground tanks) and the tanker truck filling stations (maximum flow of 60 m³/h) come under a procedure of declaration.

THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

The accident:

On 15 October around 5.00 pm, the driver had loaded the tanker truck in Lyon and collected the key to the depot from the office of the storage company in Cusset. The guidelines were indicated to the driver, who then entered the depot all alone to empty the contents of the tanker in the aboveground tank 3.

The tanker truck in aluminium was manufactured in 1979. It included five compartments of 13, 2, 4, 3 and 15 m³ capacity. The delivery was planned for 34 m³ of domestic fuel oil and the 3m³ was empty.

The transfer was done using the tanker's motor pump (30 m³/h) placed in a metal box and powered by a gasoline engine whose exhaust was not fitted with a flame arrestor. The entire transfer circuit was 80 mm in diameter. The cargo hose connecting the suction hole of the pump to the 5 valve manifold of the tanker is owned by the (distance 1.20 m) carrier company and is part of the on-board equipment. The cargo hose connecting the pump discharge and the fixed supply tube belongs to the depot and remains connected to the building. The trailer is earthed by the supporting metal coils of the cargo hose.



Source : DRIRE

Tank motor pump

At 6.00 am, the tanker unloading operation was almost over (around 30 m³ emptied into the tank).

At 6.10 pm, the driver sensed a light deflagration and observed a fiery leak below the central part of the semi-trailer at the transfer pump.

He tried in vain to put out the flames with a dry chemical extinguisher fitted to his vehicle. Since he was unable to extinguish the fire that was damaging the cargo hose used for transfer, he tried to close the valves and stop the motor pump but was again unsuccessful due to the rapidly spreading fire.

He then went to the doorway to sound the alarm. When he arrived closer, the tank exploded. The fire spread to the entire transfer zone and according to several witnesses, the flames were about 10 m high.

The firemen arrived around 6.20 pm and fought the flames with foamite nozzles for 30 min. before containing the fire.



The destroyed tanker truck and the remaining foam on the morning of 16 October

Consequences:

The accident had several consequences:

Human consequences

The driver sustained superficial burns on his left hand and face while a fire-fighter sustained eye injuries.

Material consequences

Material damage was limited to the inside of the depot:

- one tanker truck was destroyed
- two tractors were damaged
- the tanker truck filling station was destroyed

Soil pollution:

After reading the level on the measuring rod of the fixed tank, 18 m³ of domestic fuel oil was estimated to have been spilt. A part of the domestic fuel oil was also drained away from the storage tank.

Hydrocarbons transported inside the depot by the water sprayed by the fire-fighters spread and seeped into the soil. Despite setting up cut-off sand barriers and spreading absorbing material, a part of the hydrocarbons spread to the outside polluting the pit on the public way.

As part of rehabilitating the site, at least a surface of 500 m² representing 850 m³ of land in terms of volume is treated by in situ biodegradation.



Cleaning operations after the accident

Water pollution:

Setting up the cut-off sand barrier, spreading absorbing material and blocking drains helped curtail water pollution. The residual liquid fractions were rapidly pumped out. 10 m³ of water polluted by hydrocarbons was recovered.

Traces of hydrocarbons were detected in the sewage treatment plant in the Vichy-Cusset metropolitan area and in the JOLAN, SICHON and ALLIER rivers without any special damage.

The operator estimated the site rehabilitation operations at 3 million Francs in 1996 (570,000 euros in 2007).

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:

Dangerous materials released			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human and social consequences			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environmental consequences			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Economic consequences					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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

The "dangerous materials released" index is assigned level 1 due to the 18 m³ of domestic fuel oil released or burnt during the accident (Q1 parameter).

The "human and social consequences" index has been assigned level 1 as the driver and the fire-fighter sustained injuries (H5 parameter).

The 10 m³ of polluted water recovered (Env. 12 parameter) and traces of hydrocarbons detected in the banks of JOLAN, SICHON, and ALLIER rivers (Env 14 parameter) explain the level 1 assigned to the "environmental consequences" index.

Site rehabilitation operations estimated at 435,000 € (Ecu 1993) justify level 3 for the "economic consequences" index (€18 parameter).

ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

The rubber part of the cargo hose connecting the tanker manifold valve to the pump suction eye was completely destroyed in the fire. The metal ends with quick coupling and the metallic supporting coils are the only visible remaining parts. These ends bear the marking PU4 PE6 indicating the maximum and test working pressures.

The cargo hose connecting the pump discharge to the metal piping of the depot supplying the storage tanks was also damaged during the fire even if its state could not be assessed before the accident.

The inspection authorities of classified facilities support the theory of a leakage in the pressure port of the cargo hose or at the coupling leading to the formation of a hydrocarbon "fog" that was ignited by the pump exhaust. According to the driver, the motor pump exhaust is often red hot at the end of the transfer. Moreover, the gasoline engine of the pump was not fitted with a flame arrester while the magnetic drive device of the latter generated sparks.

The accident was above all marked by the speed at which the fire spread, preventing the driver from extinguishing it and causing the tanker truck to explode in about 5 min. Moreover, the previous presence of hydrocarbons in the transfer area aggravated the accident.

The location of the sectional valves of the tanker truck, the control devices of the motor pump and the portable extinguisher of the tanker truck, absence of retention, and sloping area also contributed to the rapid spreading of the fire.

ACTION TAKEN

A suspension order dated 18 November 1993 stopped all operations in the depot. The operator had to take the following measures to resume operations:

- stripping of the superficial soil polluted by the hydrocarbons
- disposal and treatment of the polluted soil in a dedicated and certified facility
- carrying out a study on residual subsoil pollution and its treatment
- ensuring compliance of the depot with the recommendations applicable to domestic fuel oil storage and distribution facilities de FOD coming under the procedure of declaration

Further to the suspension order, the most polluted parts of the soil were stripped off and the soil was stored in a leak proof tank in a shed on site. At the same time, a pollution diagnosis was carried out in two phases by a specialised company from 18 to 21 January 1994, and 31 January to 2 February 1994 to precisely identify the extent of pollution. This study revealed high levels of hydrocarbon pollution (until 11,000 mg/kg) that was however confined to the superficial backfill layers and low points of the site.

Further to this observation, the design office suggested:

- in addition to the initial stripping, excavation of soil containing hydrocarbon levels higher than 1,500 mg/kg
- in situ treatment of the excavated soil using an in situ biodegradation method ("Land Farming") lasting approximately 20 months.

The inspection authorities of classified facilities required the operator to implement the additional recommendations put forth by the specialised company by taking however 1,000 mg/kg as the threshold to determine the portions and quantities of soil to be excavated and by extending stripping to include the edges of the storage tanks.

Site cleanup operations started in the first half of 1995. 850 m³ of land was treated by in situ biodegradation. Various soil samples were tested during 1996 to ensure that hydrocarbon levels did not exceed 1,000 mg/kg. Percolation and infiltration tests were also carried out.

Following the site rehabilitation operations, easements to limit the use of land on the transfer area were put in place and since there was no water circulation at the boundaries of the site, no monitoring measures were recommended.

LESSONS LEARNT

The enquiry conducted by the inspection authorities of classified facilities highlighted major non-compliance with the security regulations contained in "standard orders" especially:

- the fixed and overhead metal piping supplying storage tanks along the transfer zone were not protected from shocks resulting from the false manoeuvres of the vehicles
- The overhead tanks did not have an earthing equipotential bonding. There was no earth electrode to ensure equipotential bonding of tanker trucks before any transfer operation;
- The transfer area was not impermeable and not fitted with a device to recover any accidentally spilled hydrocarbons;
- No device was present to avoid hydrocarbons from directly spilling onto the drains or natural environment
- Transfer operations were carried out without supervision by transfer technician
- No maintenance and operating guidelines for the storage were drafted or applied

The absence of flame arrestor on the pump was also a violation of the law on transportation of dangerous materials.

Compliance with the applicable regulatory measures and especially the presence of a depot technician in charge of ensuring compliance with unloading procedures and taking action in the event of a fire would undoubtedly have reduce the environmental impacts.

Lastly, the prompt arrival of the emergency services ensured safety and protection of the other facilities in the site and the neighbouring depot.

The depot is no longer operational and has been completely decommissioned.

Accidentology reports several cases of explosion followed by fire while loading/unloading tanker trucks transporting liquid hydrocarbons:

- ARIA 4981 - La Guerinère accident dated 29 November 1993
- ARIA 12091 - Montmirail accident dated 04 December 1997
- ARIA 12060 - Reichstett accident dated 10 December 1997
- ARIA 29652 - Valdahon accident dated 15 April 2005
- ARIA 32829 - Accident in a refinery in Italy dated 8 September 2004