

# Major Technological Risk

An Assessment of Industrial Disasters

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## FEYZIN 1966

The refinery at Feyzin was put on stream in 1964; it was to process 1.7 million tonnes a year ; it had had auxiliary installations which included mainly overhead tanks of liquid hydrocarbons of 300.000 m<sup>3</sup> capacity. These stores were in zone B of the refinery area. There were, among others, two spherical tanks which could hold 2.000 m<sup>3</sup> of butane and 1.200 m<sup>3</sup> of propane (the four spheres of propane were numbered from T.61.440 to T.61.443). The following extracts are from the verdict handed down by the Court of Appeal at Grenoble in 1971 (27, 28).

Preliminary technical explanations. In order to avoid excessive internal pressure in the sphere in case of an accident or a conflagration each sphere is equipped with a safety device consisting of two valves installed in the upper part of the sphere, yielding 73 tonnes/hour of gaseous products.

Each also contains a cooling device consisting of two rings of vaporisers installed at the top, the median part and the lower part of the tank respectively. This device is directly connected to the fire extinguishing network by a valve. Its average yield is 2.200 litres/minute for the propane spheres.

The nature of liquefied hydrocarbons requires frequent draining during storage to eliminate the water and soda mixed with the product which after pouring off accumulate in the lower part of the tank.

The draining of the spheres is effected by means of two valves located at 5 centimetres distance from each other and are operated by a square key-lock, the lower valve serving as an evacuation pipe that drips into a square draining trap of 50 centimetres side-length and 1 metre depth, linked to the network for used water from the refinery.

On the other hand, gas samples are taken from time to time for analysis of the manufactured products and checking of their standards (28, pp. 38-39).

Antecedents of the accident of January 4, 1966. The draining of manufactured products practised from the start of storage on site (June 12, 1964) had brought to light some problems arising from the device :

- The valves were too close to each other, as the passage of propane from liquid to gaseous state .which took place at a temperature of minus 44°C caused an almost simultaneous icing up of both valves ;

- Their control by removable keys rather than wheel key-lock presented risks of gas escape in case one of these keys being dropped ;
- Their diameter (2 inches) was too large ;
- With the draining trap located at the feet of the operator, which meant that he was frequently splashed and sometimes suffered burns to his face and hands by the gushing of liquid into this opening.
- The valves were often difficult to operate.
- Finally, the access to the valves was made difficult by the presence of pipes which the operators had to step over in order to carry out the draining.

Employees had told the management about these problems ; things remained practically as they were. Two serious incidents had occurred that gave substance to the apprehension and fears expressed :

a) On August 6, 1964 at about 23.00 h one Robert Tinjod, an operator's mate, had opened - before massively draining the butane sphere 462 - completely the two valves of the tank, letting the liquid flow normally into the drainage tank, and he had climbed on top of the sphere in order to check the gauge there, thinking he had enough time before finishing the draining operation. It was then that the gas shot out in force.

Tinjod who wanted to shut the valves which were iced up by the passing gas froze his right hand slightly and had to be treated in hospital.

The draining taps were shut by a manufacturing engineer and one of the firemen on duty who were helped by a favourable wind.

b) On February 26, 1965 at 11.05 h one Isaac Bittoun a chemist, had been assigned with his colleague Godde to carry out the draining of the propane sphere 440 to take a gas sample.

In these ill-defined circumstances, after the usual emission of water and soda the propane shot out and burned the two men. The safety workers Leseurre and Rossit, after being alerted, intervened. The first one was also burned but the second one managed to shut the valve. The alert had been serious.

This last incident which if the wind had not again been favourable could have developed into disaster even though the motorway had not yet been opened to traffic had subsequently caused the issue of a service bulletin on the method of draining the spheres (March 4, 1965) by Mr Ory, the Chief of Technical Services. It said in particular that after the keys had been attached to the two draining

valves the valve on the sphere side was to be opened completely, then the valve on the atmosphere side partly opened, without ever opening it completely in order to be sure that it could be closed, as soon as gas appeared, the closure of the draining valve or, in normal circumstances, of the valve on the sphere side, and then shut the second valve.

Additionally, this instruction indicated, for the control draining on the bottom of the sphere, the facility of using the piping between the two taps as a lock-chamber i.e. by opening the valve on the sphere side, shutting it again immediately, then opening the second valve to the atmosphere in order to empty out the content of the line.

It finally made it obligatory that the taking of laboratory samples had to be done in the presence of a safety officer and that draining was to be carried out by two people.

This bulletin which was entered into the service manual and posted in the pump rooms was generally known to the staff but had never been backed up by practice exercises. Also, some operators kept to their own ideas about the question and to the procedures previously practised (28, pp. 39-41).

The conflagration on January 4, 1966. On January 4, 1966 it had been decided to clean propane sphere 433 at the end of sample taking. Taking part were : Robert Dechaumet, operator's mate, Raymond Fossey, safety officer and Bernard Duval, laboratory helper.

In contravention of the instructions in the service bulletin from Ory this operation was carried out at 06.40 h, i.e. in complete darkness; the lower part of the sphere was lit by the diffused light of a candelabrum and horizontal projectors placed at a certain distance. The temperature was between 4 and 5°C, and there was virtually no wind.

Contrary to instructions Dechaumet first half-opened the lower valve, then fully opened the upper valve, as it emerges from the experts' statements on the pieces recovered as well as from those made by Fossey. The latter whose function it was to watch the work and to intervene if need be did not budge but looked on from a distance. Some dirt ran into the drainage tank, then suddenly the gas shot out in force and struck the operator in the face and on the body.

Dechaumet, caught in the cloud, lost his safety goggles and involuntarily unhooked the operating key of the upper valve the fixing nut of which had actually not previously been tightened on the operating square.

Fossey shouted : "You have opened it too wide." Dechaumet who had recovered slightly tried to shut the upper valve but did not succeed

in putting the key back on because of the icing caused by the escape of gas. He forgot to try and close the lower valve on which the key was still fixed and refused to keep trying.

Meanwhile Fossey and Duval had raised the alert over the telephone and the "généphone". The three safety officers, Rossit, Roy and Fossey, tried in turn to stop the escape, without success.

Gas escaped from the sphere which at 05.00 h in the morning had held 693 m<sup>3</sup> of propane at the rate of about 3.3 m<sup>3</sup> per second according to the calculations made by the experts. The gas mixture, being heavier than the air and there being hardly any wind blowing, the propane expanded by gravity in the direction of the motorway. Nobody thought of alerting the fire service, the gendarmerie and the CRS.

The cloud, approximately 1.50 metres high, reached the motorway on which there were a number of vehicles between 06.55 h and 07.05 h. Employees from the refinery and from the guard of the factory then intervened on the motorway and on the CD 4 road to stop the traffic. At 07.15 h Robert Amouroux, driving his CV4 Renault, arrived on the scene ; he was going from Serezin du Rhone (Isere) to Feyzin to take up his duties in a company working for the refinery. When he arrived at the cross-over linking the CD 4 with the motorway and crossed the gas cloud the latter, no doubt as a result of a spark produced by the vehicle, caught fire.

panic-stricken Amouroux stopped his car and got out ; his clothes caught fire ; he ran and threw himself into a ditch a few metres away. He a quarter of an hour later, severely burned, and taken to hospital where he died on January 8, 1966.

The scene had been observed By the neighbouring customs post who telephoned the gendarmerie at Saint Symphorien d'Ozon which immediately sent their available staff to the scene. The CRS for their part acting on their own had obtained information on what was happening and shared the work required with the gendarmerie : stopping vehicles on the exposed roads, isolating the danger zone, evacuating the houses and the school of the Razes area of Feyzin which was in serious danger.

Sphere 443 had caught fire : it was a drinks retailer who telephoned the fire brigade in Lyons at 07.12 h. Two other phone calls were received from the refinery a bit later. The direct telephone line had not been used.

At the factory general alert was raised by a siren while the three professional firemen on duty who had been unable to plug the escape tried in vain to extinguish the fire of the sphere by attacking it with powder extinguisher and activating the fixed cooling system of the eight spheres and of the two liquefied hydrocarbon towers.

The stock of powder (1.500 kg) being quickly exhausted, Rossit, the chief of the group, tried unsuccessfully to use the foam extinguisher which he had available. This piece of equipment could not function due to lack of water suction; a foam launcher could not be used for lack of pressure.

In fact, while the fire fighting network of the refinery was designed to deliver a maximum of 800m<sup>3</sup>/hour of water the simultaneous opening of the cooling systems for the propane and butane tanks by the safety officers required the use of 1.128 m<sup>3</sup>/hour. Therefore, from the beginning of the fight against the fire, water was in dangerously short supply. The situation was aggravated by the fact that the neighbouring Rhone Gas Company which also used the water supply network of the refinery had, as a precaution, also started the cooling system for its two propane spheres and was hosing them with a fire hose.

The fire brigade from Lyons arrived on the spot from 07.33 h onward in successive pickets led in turn by the Adjutant Prevost, Commander Legras (from 07.43 h) and Commander Pierret (from 07.46 h). They joined their efforts with those of the professional and auxiliary firemen from the refinery and were in turn joined by members of the fire fighting team of the nearby Rhodiaceta factory at Saint Fons (Rhone) who arrived at 08.20 h and the fire pioneers of Vienne who after being alerted by the Commander from Lyons arrived at 08.28 h.

As chief of the first intervention picket from Lyons adjutant Prevost occupied himself immediately with sphere 443 which he tried to extinguish with the help of the foam launchers. Being unable to succeed he abandoned the burning tank and concentrated his efforts on the neighbouring propane tank 442.

The rescuers giving up the attempt to extinguish the fire devoted themselves exclusively to the cooling of the other tanks to prevent them from catching fire and hoping that sphere 443 would empty its content which burned as soon as it entered the atmosphere.

However, faced with the drop in pressure already mentioned, Adjutant Prevost and subsequently Commanders Legras and Pierret decided to put a special high powered fire engine for hydrocarbon fires on suction in the Rhone canal, but for lack of adequate fittings this was sucked in and could only be recovered after some twenty minutes.

On the other hand, the rescuers were handicapped by the customs enclosure the doors of which were padlocked. Employees of the refinery forced the padlocks and then demolished the enclosure with an excavator.

Meanwhile, reinforcements had continued to arrive and authority was passed first to Commander Legras, then to Commander Pierret.

At 07.45 h the important event mentioned above occurred : the release of the safety valve of sphere 443 ; the gas which escaped through it caught fire immediately causing a fire column of some ten metres in height. This incident was interpreted as reassuring by some of the people in charge at the refinery\* : it indicated according to them that the sphere would empty itself completely. They told Commander Pierret and some of his co-workers so.

However, some of the rescuers were gripped by a mute apprehension born of the considerable increase of flames enveloping sphere 443 and the growing turmoil caused by the conflagration.

As to the manner in which the accident was attacked, Commanders Legras and later Pierret had confirmed the measures taken by Adjutant Prevost, restricting themselves to a role of preventing the spread of the accident by hosing the tanks that were likely to catch fire.

The lowering of pressure constrained the rescuers to a dangerously close approach to the tanks as the water from their launchers reached the top only with difficulty. This dangerous situation determined Commander Legras to pull his men back after they had fixed their launchers in firm hosing positions.

Nearly one hundred and seventy people were then in area B.7/1 and in the other areas of zone B. They were firemen from Lyons and Vienne, professional and auxiliary firemen from the refinery and from neighbouring companies or companies working for the refinery, the director, department heads, employees of the factory, supervisors and staff from neighbouring factories and spectators.

The explosion of sphere 443 which occurred at 08.45 h struck most of these people. Added to the waves of burning gas caused by the deflagration were pieces of steel, some of them of considerable weight, that were hurled in some instances over several hundred metres.

Seventeen rescuers succumbed to the explosion or later on to their severe burns. Among the eighty four injured (...) forty two suffered complete disablement for work for more than three months.

However, the explosion had extinguished the fire in the whole of areas B.7/1 and B.7/2 and the southern part of area B.11. The rescuers whose courage had been above praise and some of whom had saved the lives of colleagues in danger while risking their own lives then fell back, taking the injured with them.

\* Our underlining.

On account of the explosion of sphere 442 at 09.45 h did not cause further victims but, like the preceding one, did cause much material damage as far as 16 km away at Vienne.

Between the two blown-up spheres a crater, 35 metres long, 15.40 metres wide and 2.10 metres deep had opened up (28, pp. 41-45).