Fire outbreak in a silo at an agricultural cooperative

29 June 1999

Lusignan (Vienne)

France

Fire
Food handling facility
Silo
Cereal
Dust deposits
Prevention measures

THE FACILITIES INVOLVED

The site:

This agricultural cooperative, responsible for operating the Lusignan silo (with a storage capacity of 40,500 tonnes), comprised nearly 7,700 members and employed a total workforce of 163. The facilities were installed in a manufacturing zone. The silo was located 60 m from the Poitiers-La Rochelle railway line, 80 m from a building materials warehouse (for the first third) and 160 m from the closest dwellings.

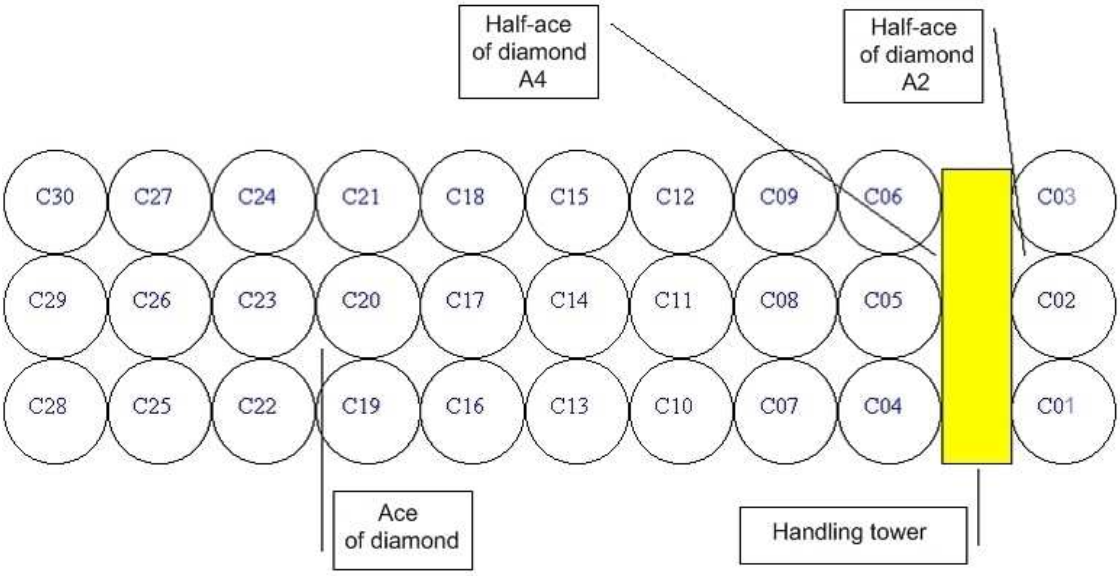
The specific unit involved:

This vertical, reinforced concrete silo, with a capacity of 53,815 m³, was composed of 3 rows of 10 circular cells, each containing 1,500 to 1,600 m³, in the form of 16 "ace of diamond" (intercellular spaces) ranging between 220 and 450 m³ and 4 "half-ace of diamond".

The 60-m high handling tower contained some 10 hoppers used in transferring cereals, especially for rail shipments. The 40-m high cells were covered over their upper part by a homogeneous concrete slab topped by a gallery housing material handling equipment.

The silo was built in two phases: the tower and 12 cells in 1974, then the 18 other cells in 1981.

These installations were specifically classified by Prefecture order dated 6 June 1977.



Summary diagram of these installations (Regional department environment, Poitou-Charentes)

THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

The accident:

Around 10:15 am during one of his regular inspections, the silo manager discovered smoke escaping from an air purifier at the 48-m height level of the tower. The smoke was still not visible on the inside. The manager decided to shut down silo operations at 10:30 am.

His assessment led him to the pendular device (distributor used to direct grain to the various destinations), located below this purifier, and to 2 of the "half-ace of diamond" A2 and A4, installed on both sides of the tower. The quantity of smoke released was considerable, yet without any flame burning. He notified public emergency services at 12:10 pm.

Fire-fighters completed a thorough survey of the site and then sprinkled water inside the "half-ace of diamond" cells. The sludge accumulated inside the A4 capacity was discharged once the lower hatch had been opened, following which the cell could be ventilated using a hydraulic turbine driving a fan (explosion-proof equipment). The lower hatch of the other "half-ace of diamond" could not be opened; natural ventilation was created by disassembling the drain pipe. A rail loading hopper was drained by gravity and its corn contents emptied into the cooperative facility's courtyard.

The site manager, accompanied by the lead rescue officer and the Classified Facilities inspector, were undertaking a systematic inspection of the storage cells when smoke and a burning smell were once again perceptible at the level of the pendular device. The smoke was in fact originating from the previously emptied rail loading hopper. Fire-fighters sprayed water inside the capacity using a nozzle and left the space to ventilate naturally.

Once the smoke had dissipated, the inspection of cell spaces, the "ace of diamond" capacities and tower equipment could resume. The fire was declared extinguished at 7 pm.

Consequences of this accident:

No injuries were reported. The installations were not damaged by the fire or by the release of fire extinction water. The silo was once again operable following departure of the fire-fighting crew.

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:

Dangerous materials released	☐	☐	☐	☐	☐	☐	
Human and social consequences	☐	☐	☐	☐	☐	☐	
Environmental consequences	☐	☐	☐	☐	☐	☐	
Economic consequences	☐	☐	☐	☐	☐	☐	

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

Since no human, social or environmental consequences had been recorded and moreover none of the installations damaged, all scale parameters were scored a "0" rating.

THE ORIGIN, CAUSES AND CIRCUMSTANCES SURROUNDING THIS ACCIDENT

When the smoke release was discovered, the two cells C3 and C6 plus the 2 "half-ace of diamond" A2 and A4 fed by the pendular device were all empty. In contrast, the rail loading hopper contained 200 tonnes of corn subsequent to a train loading performed the day before. No combustible had been discovered in the cereal storage when this cell capacity was drained by the emergency response crew.

The combustion had in fact been caused by the pendular device for an unidentified reason. The fire then spread into the 2 "half-ace of diamond" cells and the loading hopper through the combustion of dust stuck onto both the ceilings and interior walls, yet this outbreak did not reach the two cells C3 and C6, which were scheduled for filling.

Dust had accumulated on the upper part of the storage cells over a height of approx. 1 m. These zones were not cleaned of dust during cereal transfer operations and moreover remained difficult to access during periodic maintenance due to their top closure system, featuring a concrete cell lid. The dust thickness extended several centimetres, most notably inside the rail loading hopper, which was being systematically used to empty the silo storage cells.

The large quantity of sludge recovered after sprinkling the interiors of the "half-ace of diamond" cells and the hopper attests to the magnitude of dust deposits accumulated on the silo walls.

ACTIONS TAKEN

Since the Blaye disaster on 20 August 1997, the Lusignan silo (built according to an identical design) had received close monitoring. A study aimed at defining the equipment to be installed on the silo to mitigate the effects of a potential dust explosion had been ordered by Prefecture decree dated 27 January 1998. Delivered in September 1998, this study had been submitted for critical analysis to a third-party body, which developed a series of recommendations; the site operator was requested to propose a timetable for approval by the Classified Facilities Inspectorate.

The rail loading hopper, which contained a volume of 400 m³ (capacity: 300 tonnes), and the other hoppers present inside the handling tower (with capacities ranging from 15 to 250 tonnes) had not been incorporated into the study ordered in January 1998. Subsequent to this accident, the Classified Facilities Inspectorate required the operator to supplement the initial analysis to include these capacities.

Moreover, the operator had already initiated, for installations across all sites, a compliance control programme addressing the other prescriptions cited in the Ministerial decree issued on 29 July 1998 relative to silos; this programme focused on introducing lightning protection and centralised dust suction systems.

LESSONS LEARNT

Although this accident produced no adverse consequences, it still led to stimulating the completion of a safety report that took into account the hoppers already installed inside the handling tower.

Along the same lines, this accident justified the operator's immediate implementation of a number of recommendations forwarded by the third-party body concerning the handling tower, namely:

- √ continual state of cleanliness and choice of well-adapted systems or their modifications to suit the tower,
- √ isolation of the tower with respect to the gallery running above the storage cells and the space beneath cells.

This event recalled the importance of efficient cleaning techniques for dust inside silos and, more specifically, the problem of dust accumulation within the upper part of capacities (which remains a problem to this day), as illustrated by several fires recorded in the ARIA base over the past few years (nos. 36659, 39873 etc).

Such accumulation of combustibles in relatively inaccessible zones for cleaning has given rise to combustion accidents, particularly during hotspot work outside the cell's protective roof. Several risks are to be feared in cases like these: smouldering fires in grain stocks in the event incandescent particles fall onto the pile, or dust explosions when filling enclosed storage cells. This "unique" aspect associated with cleaning in remote zones warrants close monitoring, especially when considering that in the case of the Lusignan silo, the Classified Facilities Inspectorate had never even reported the excessive dust accumulation in installations during its previous site inspections.