

## Explosion in an explosive warehouse

June 27, 1993

Mazères – [Ariège]

France

Fire  
 Domino effect  
 Pyrotechnics  
 Reduced activity  
 Tolute  
 Detonating cord  
 Animals  
 Property damage

### THE INSTALLATIONS IN QUESTION

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#### The site

Surrounded by a "non edificandi" [building prohibition] zone of 300 ha, the pyrotechnic manufacturing site extends over 100 ha and also includes two 70 m<sup>2</sup> storage units spaced a distance from each other, as well as administrative and manufacturing buildings.

The company, having a workforce of 145, manufactures its products not only for the military (firing plugs for grenades, training grenades, and close range defence systems for tanks), but also for civilian applications (rain rockets, railroad alarms, and marine signalling devices...).

### THE ACCIDENT, ITS BEHAVIOUR, EFFECTS AND CONSEQUENCES

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#### The accident

On Sunday, June 27, at 4.40 pm, a violent explosion ripped through warehouse D22 used to store nitrate explosives, detonating cord and various other explosive products such as igniters, plaster grenades, and bomblets...(class 1.1F).

Fire ensued and destroyed two other warehouses (D13 and D18 located 60 m away. Two guards sounded the alarm. The explosion, heard up to 30 km away, also damaged workshops, storerooms and offices. After having extinguished burning dry vegetation to protect the remaining installations, the firemen managed to extinguish the fire around 9.00 pm.

The following day, the burned out warehouses were flooded to prevent any risk of explosion and tarps were used to protect the damaged warehouses. The 145 employees applied for technical unemployment benefits.

#### Consequences

The accident took place over the weekend, and claimed no victims.

The accident had no environmental consequences.

Property damage was extensive: 3 warehouses (D22, D13 and D19) destroyed. The blast from the explosion damaged the inert substance warehouses and offices. The siding and roofs of the other warehouses were damaged by the shock wave, although none of the pyrotechnic products stored there were set off. Broken windows and damaged light-weight structures were reported outside the storage areas. Roof sheeting and wall siding were peeled back like flower pedals although the machines remained in place in the buildings. The employees who were granted advance leave resumed work in early August. The amount of property damage reached 14.6 MF (2.22 M€).

#### 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.

Dangerous materials released		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" 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"/>	<input type="checkbox"/>
Environmental consequences		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Economic consequences		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<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.ecologie.gouv.fr>.

The 1.77 t of tolite, representing 3.5% of the corresponding Seveso threshold (50 t – explosive substances classified in a division other than 1.4 as per the European Agreement Concerning the International Carriage of Dangerous Goods (ADR) (United Nations)), which equals level 3 of the "quantities of dangerous substances" rating per parameter Q1 (Q1 between 1% and 10%).

The 1.77 t of tolite that exploded represents 1.77 t of TNT, which equals level 3 of the "dangerous materials released" index according to parameter Q2 (Q2 between 1 t and 5 t).

The overall "dangerous materials released" rating is thus 3.

The €15 of the "economic consequences" rating is 3: the amount of property damage is estimated to be 14.6 MF, or roughly 2.22 M€ (€15 between 2 M€ and 10 M€).

## ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

The investigations conducted by the INERIS and the court-appointed experts, coupled with the guard's testimony, allowed the probable accident sequence to be reconstructed:

- The most plausible origin is the accidental triggering of blasting caps and hand flares. Rodents, whose presence had already been detected in the warehouse, may have been the cause.
- For several minutes, the fire may have spread to other caps or cardboard packaging. After a certain period of time, the fire eventually reached and detonated the detonating cord, forming a small crater.
- The products, dispersed by the first small explosion, caught fire. The fire then spread to the 1.1 F class hail rocket motors (nitrate explosive). This then led to a partial detonation, forming a crater 1.6 m in diameter and 0.25 m deep.
- Roughly twenty seconds later, nitrate and pentolite TNT (tolite) type explosives detonated, also forming craters. The largest measured 5.4 m in diameter and 1.5 m deep. According to the calculations, the explosion corresponded to 1,77 t of TNT (tolite), blew out the building's metal structure.
- A smaller crater (0.5 m in diameter and 0.25 m deep) corresponds to the partial detonation of the detonating cord.
- The blast effect severely damaged two neighbouring warehouses and deformed the structure of D19. Building D19, which had already lost its siding, was hit by the projections of hot metal debris which ignited power stored there and caused the cases of black powder to explode.
- Considering the nature of the substances stored, warehouse D13 burned relatively slowly leading to the explosion of signal flares. The combustion of smoke generating materials released thick black smoke visible from Pamiers.

## ACTIONS TAKEN

Before resuming activities at the site, the operator had to provide the Prefect with an analysis of the accident's causes, a description of the temporary measures for the pyrotechnic product storage facilities. This report was examined by the Classified Installations Inspectorate (CII) and the IPE ("Inspection de l'armement pour les poudres et explosifs", Armament Inspectorate for powders and explosives).

Within less than 6 months, the operator was required to provide the inspectorates a dossier that included, among other elements, a danger study including the lessons learned from the accident. The Prefectoral order of 07/26/1993, issued after the inspectorates' examination of the primary analysis of the cause of the accident and the description of the temporary pyrotechnic product storage measures, authorised activities to be resumed until 01/15/1994 according to the requirements established to ensure a sufficient level of risk prevention :

- the provisions of the Prefectoral order of 09/24/1984 remain applicable,
- the removal and destruction of explosive products whose packaging was damaged,
- the assignment of warehouses prescribed during the temporary operating period,
- reconstruction operations in accordance with certain safety and monitoring requirements,
- tightened surveillance of the warehouses during the temporary operating period,
- a daily inventory of products stored in each section – and the inventory is sent to the CII.

Based on the safety study, causal analysis and the opinion of the IPE, the Prefectoral order of 01/10/1994 governing the warehouses replaced that dated 09/24/1984 and stipulates the following:

- the modifications of the stamping conditions (identical total quantity although distributed among several warehouses) in order to avoid incompatibilities between substances and to ensure better management of the quantities stored in each cell,
- the warehouse construction method and protection against intrusion by animals,
- the operating rules: transport, maintenance, treatment of wastes, general and individual protection measures, internal contingency plan.

The reconstruction of the destroyed installations was subject to a new authorisation procedure.

## LESSONS LEARNT

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This accident offered a wealth of information regarding the origin and the sequencing of the explosions, and the type of combustion that followed: the sensitivity of the substances in question, storage method, risks associated with the presence of parasitic animals, domino effects, type and extent of the damaged materials...