| Flammable Solids & Dusts | | | |
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# EXPLOSION IN A GRAIN SILO - BLAYE

**by S Wright**

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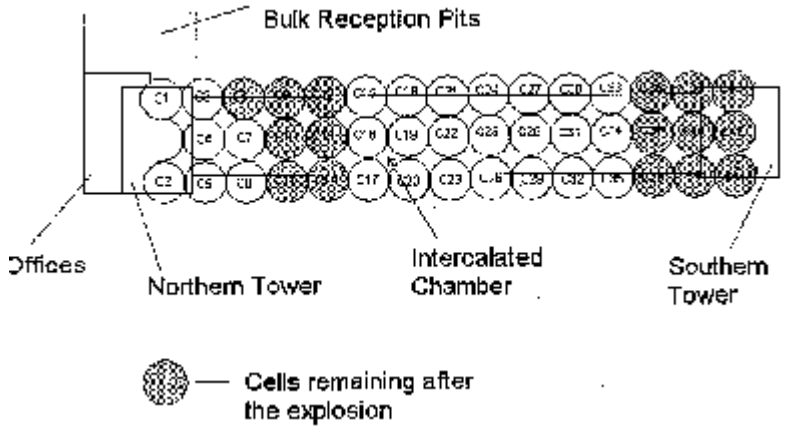
## Introduction

On Wednesday 20 August 1997 an explosion occurred in a grain storage complex killing 11 people. The silo belonged to Société d'Exploitation Maritime Blayaise (SEMABLA) at Blaye in France. This summary draws from the official French report into the incident.




The complex was made up of 44 cylindrical cells each 6.2 m diameter and 36.5 m high. The intercalated chambers between the cells were also used for storage. The combined capacity of the cells and chambers was 37200 tonnes of grain. A mixture of wheat, corn and barley was stored.. At either end of the cells were towers containing various bucket elevators, weighing equipment, dust removal system, and electrical equipment associated with a radiocommunications station. Over the top of the cells was a gallery housing conveyor belts. At the foot of the northern tower were offices and the bulk grain reception area. The cells, towers and gallery were of concrete construction and were not fitted with any form of explosion relief. Close by were a number of sheds also used by SEMABLA for grain storage.
The dust removal system consisted of a centralised collection system which extracted dust from a number of locations including:

- the head of chain conveyors
- two points on each bucket elevator (bottom and top)
- on the motor housing for each bucket elevator
- on two belt conveyors in the northern tower at the point of loading
- at the head of two redler conveyors used for transferring grain from the reception pits.

Six of the victims were found in the offices. The sudden nature of the incident and the close proximity of the silo to the offices meant that they had no time to react and their bodies were found at their workplaces. Significantly sized pieces of debris from the explosion were found up to 100 metres from the silo although one piece of breeze block weighing approx. 10 kg was reported to have been discovered at a distance of 140m.
The investigation carried out by INERIS considered two possible conditions that could result in the formation of an explosive atmosphere:

- combustible gases within the storage units due to auto-overheating, fermentation or an incipient fire;
- a flammable dust / air mixture.
- The first of these was ruled out by the investigation.

Several sources of ignition were considered including:

- mechanical sparks or overheating (including hot surfaces);
- static electricity;
- electrical sparks;
- auto-ignition of a deposit.

The investigation concluded that the most likely sources of ignition were either a malfunctioning or a fault in the fan on the centralised dust collection system, located in the northern tower, or auto-ignition brought about by an overheating of the dust collected coupled with a high ambient temperature. From the handling tower the explosion travelled along the gallery.aided by either dust deposits or a dusty atmosphere or both.
The flames from the explosion penetrated the open silos producing a further violent explosion.

**Lessons**

The investigation report includes a number of lessons/recommendations to be learnt as a result of the incident. Many of these have been identified previously following other incidents.

- Structures housing grain handling equipment (handling tower, galleries) and the storage units should be fitted with vents.
- Intercalated chambers should not be used for storage as adequate venting cannot be accomodated if the L/D ratio is too great.
- Install dust extraction systems and the associated dust store in the open air.
    - At Blaye the dust collected was stored in the handling tower for three to five weeks before it was emptied directly into the river.
    - The centralised dust collection system provided a route for explosions to spread round the plant as a result of the network of dust-collecting shafts.
- Isolate largely enclosed structures one from another .
    - At the time of the explosion it is possible that three cells were open and connected by the concrete gallery which ran over the top of the cells.
- Install stone removing machines and devices for collecting pieces of metal.
- Install spark protectors on major pieces of equipment.
    - Requirements for new machines will be influenced by ATEX and the machinery directive.
- Storage of flammables(whether liquid or solid ) in rooms forming part of the silo should be banned.
    - One hypothesis considered was that a fire started in a room used for storing records
- Check for dust protected electrical equipment and the settings in relation to excess current.
    - Good housekeeping should limit dust deposits.
- Ensure regular cleaning of the ducts in the air blowing circuit at the foot of the cells.
    - This is only a problem if ducts become dislocated as was considered possible at Blaye
- Smoke detectors should be installed where there is a fire risk particularly in the final dust collection area.

- The distance separating the silo from third parties should be studied on a case by case basis, with the value of 1.5 times the height of the silo being a minimum distance for concrete silos. Offices and workshops should be treated in the same way.

- Consideration to be given to the use of video surveillance possibly coupled with means of detection such as opacimeters.

    - This is to enable abnormal situations to be detected at an early stage without operators having to continually patrol the plant.

- Adapt the storage temperature alarm threshold to the external climatic conditions.

    - Auto-overheating can occur if the grain is initially stored at too high a temperature or in contact with hot surfaces.

    - Temperature measurement at a single location in a large silo is ineffective.

    - We would recommend dealing with the problem at source i.e. ensure grain is dried and cooled before storage.

- Where insecticides are injected, means of preventing a malfunction of the injection device need to be examined.

    - It was considered at one stage that the flammable solvent associated with insecticide injection could have caused the incident.

## Follow Up

TD inspectors have visited most of the major grain importing terminals since the explosion at Blaye and made recommendations particularly designed to prevent an incident of this scale. One of the largest has had extensive explosion suppression systems for many years, another has been required to fit similar systems.