

Rupture of a grain storage cell

September 20, 2002

Vailly sur Aisne [Aisne]

France

Dangerous release
 Food industry
 Silo
 Grains
 Structural ageing
 Design modification
 Preventive inspection
 Studies / Expert evaluation
 Evacuation

THE INSTALLATION IN QUESTION

The site :

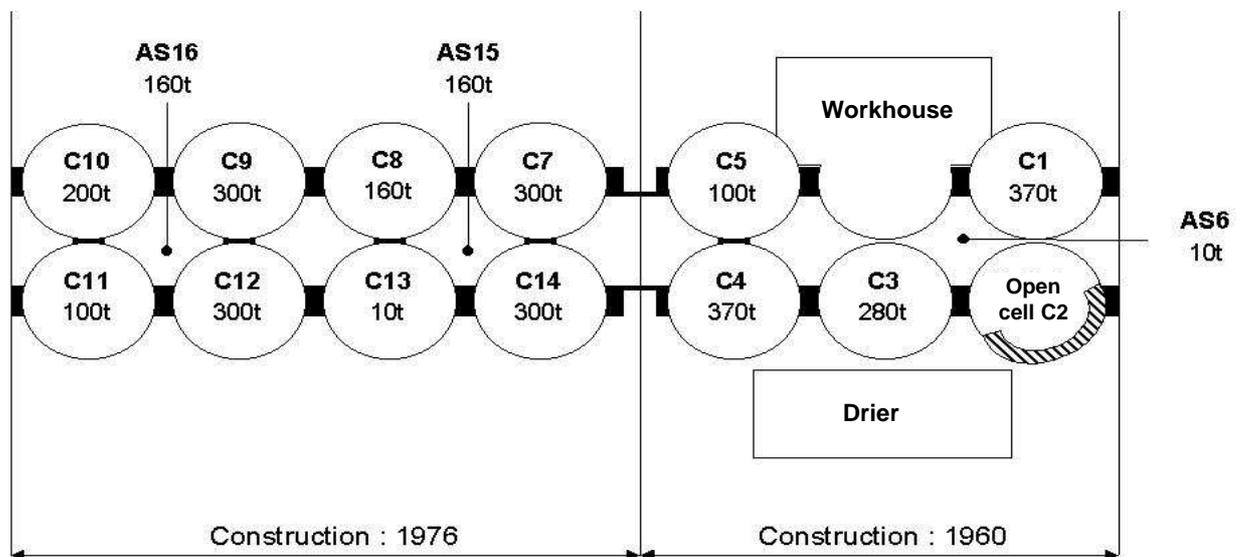
The silo was built in 1960 near the town centre of the *commune* ; the first homes are located a distance of approximately 50 m. The facilities mainly include :

- ✓ A 6,500 m³ grain storage silo consisting of vertical concrete cells,
- ✓ A 40-ton depot for agro-pharmaceutical products,
- ✓ An 42 m³ above-ground heating fuel storage tank.

The silo was built in 2 phases, one in 1960 with the installation of 5 cells, the workhouse and drier, and the other in 1976 with the construction of 8 additional cells.

The establishment is an installation subject to authorisation, governed by an "Acknowledgement of Declaration" dated July 15, 1993.

Cell identification



THE ACCIDENT, ITS BEHAVIOUR, EFFECTS AND CONSEQUENCES

The accident :

On September 20, 2002 around 11.50 am, a driver of a truck being loaded by the side unloading system of C2 noted that pieces of concrete were falling into the trailer bed. He informed the silo operator performing the unloading operation and both employees immediately moved away from the area. A few instants later, a block weighing approximately 3 tons fell into the truck. 300 t of wheat spilled onto the ground, destabilizes the drier and is blocked by the wall separating the cooperative and the yards of the residences next door.



Photo DRIRE Picardie

The consequences :

The accident did not claim any victims, although 6 people were temporarily evacuated. Property damage was extensive.

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 Vailly sur Aisne 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"/>	<input type="checkbox"/>
Human and social consequences		<input checked="" type="checkbox"/>	<input checked="" 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 type="checkbox"/>	<input type="checkbox"/>	<input 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 evacuation of the 6 local residents resulted in the level 2 rating for the "human and social consequences" index (parameter H7).

ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

The ageing of the reinforced concrete compounded by corrosion of the reinforcement rods is the main cause of the rupture of the Vailly-sur-Aisne cell, built in 1960. The expert assessment conducted showed that, since 1975, the structure of the recently built cells was reinforced with two levels of steel hoops as opposed to one before. In addition, the installation of a side drainage system on the cell attributed to the weakening of the structure, thus aggravating the phenomenon and causing the structure to collapse.

ACTIONS TAKEN

Following the accident, the site was secured and a safety perimeter was set up around the installations, cracks observed in the neighbouring cell C1 were marked, the site's electrical power supply was disconnected, the grain spilled on the ground was recovered and the drier stabilized. A crisis meeting was held in the town hall's facilities in mid-afternoon in the presence

of the mayor of the *commune*, the operator, a concrete expert, firemen, the gendarmerie and representatives from the DRIRE. Following the discussions, the mayor issued a temporary evacuation order for the residents living closest to the establishment.

The Registered Installations Inspectorate proposed that the *Prefect* issue an emergency measures order requiring :

- ✓ That the site be secured
- ✓ An expert evaluation in order to evaluate the overall stability of the silo and the possible measures required to repair or demolish the structure
- ✓ That a new Acknowledgement of Declaration be obtained prior to placing the installations back into service.

Following the expert's report, the Inspectorate proposed in February 2003 that the *Prefect* issue an order of additional requirements aimed at obtaining guarantees relative to the stability of the second phase (built in 1976) and precise information relative to the action plan for repairing the 1st phase structures. This order would never get signed as the entire installation was demolished in May 2003.

LESSONS LEARNED

If a silo can collapse from an internal explosion, it is not immediately obvious that cells can be damaged under the weight of the material stored. There are numerous causes for these structural ruptures and can, in certain cases, be cumulative : design fault, construction fault, modifications and work without sufficient prior engineering, corrosion and ageing of the materials. This accident confirms the risks of cracking and cell rupture resulting from the ageing of the reinforced concrete, particularly for cells built prior to 1975, when construction rules were modified to include a second level of steel hoops reinforcing the structure. The collapse of part of the storage facility wall also showed the need for a thorough evaluation of the cells when modifications are made.

A certain amount of vigilance would seem necessary particularly concerning older installations. Operators should check, based on construction drawings of their installations, that the civil engineering, the conformity of the construction and possible modifications. If these elements are not available or, if there is a doubt relative to safety margins, an expert evaluation by a specialised organisation would seem highly desirable.

[Silo accidents caused by a similar problem :](#)

- Jussy – Detailed report, ARIA No. 23368
- Blaye – ARIA No. 346
- Méru – ARIA No. 24293
- Monthois – ARIA No. 26862
- Nogent sur Seine – ARIA No. 25044
- Seux – ARIA No. 25819
- Villette sur Aube – ARIA No. 28394