

Fire in a refrigerated warehouse

19 August 1997

Le Havre - [Seine-Maritime]

France

Fire
Refrigerated warehouse
Refrigeration equipment
Ammonia
Paper / Archives
Fire engines
Public information

FACILITIES INVOLVED

The company that stores and manages archives occupies around two thirds of the ground floor and almost the entire first floor in a 400m long building on a pier edge. The two floors represent a ceiling height of 14 m. The port warehouse comprises three sheds (n°76, 77 and 78) with a surface area of 30,000 m².

Sections 77 and 78 of the building are separated by only one wall while the other sections are separated using a few partial partitions. A central gangway runs through the length of the ground floor and is intersected by six other crossways.

A concrete flooring separating the two floors bears large shafts, of which some are fitted with lifts.

At the time of the accident, the shafts may have been hidden with a screen containing polystyrene. Since there are low-resistance zones, they were not used for storage and were covered with railings to prevent access. The double pitch roof is cut by 22 rows of skylight representing 3,500 m² of atrium window.

Administrative situation:

Shed 78 is a reefer shed containing around 5 tonnes of ammonia. This facility has been approved by the prefectural order dated 13 March 1981. At the time of the accident, this shed was empty and all refrigeration units were switched off. These include: 3 compressors, 3 storage capacities (2 low pressure and 1 high pressure) and 1 condenser in a designated area. The evaporators were stored in the warehouse.

Other activities also come under the classified facilities regulations including:

- The warehouse where the archives were stored and was subject to authorisation
- Accumulator loading workshop that was subject to declaration.

On the day of the accident, the two above activities did not have the corresponding approvals.

THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

Chronology of events:

03.40 pm: The fire department received an "industrial fire" alert. The port's watch tower also indicated the presence of smoke.

The port's rescue centre was located on the other side of the pond near the warehouse. A pump-and-tank wagon and a ladder arrived in a few minutes.

3.50 pm: the fire-fighters implemented two large nozzles.

4.20 pm: the Le Havre port master's office informed the inspection authorities of classified facilities that a fire had broken out in a warehouse likely to contain ammonia.

Around 4.25 pm: the fire spread on both fronts from the centre of the shed to the two ends. An estimated surface area of 10,000 m² was consumed by the fire. A breeze directed the smoky cloud toward the city of Le Havre. Fire engines were called for back-up from Rouen and other neighbouring towns.

Around 4.30 pm: thermal radiation emitted by the fire at the northern front of the warehouse ignited a scrub growth near a heavy duty vehicle service station situated less than 200 m. A fire engine was sent to the site and the station was closed. At the edge of the pier, 4 cranes were also exposed to the effects of the thermal radiation. Since their cables turned red, it was feared that booms may drop.

An oceangoing tug was placed facing the southern front and used its four 6,000 l/min water cannons to protect the part of the building housing the refrigeration units.

Around 4.35 pm: two inspectors from the authorities of classified facilities observed that the building housing the ammonia refrigeration units on the 1st floor caught fire on the southern, northern and western sides. The rest of the warehouse was also on fire. The flame front was assessed to be 350 m high.

Considering the explosion and toxicity risks linked to ammoniac or its products of combustion, the following measures were urgently implemented:

- The fire control station was moved to the other side of the pond at 100 m from the warehouse
- Fire-fighting resources mainly targeted the building housing the refrigeration units
- Specific resources to counter the toxicity risks were obtained [CMIC (mobile chemical intervention unit), etc.]

The police installed road barricades and asked residents to go back home. The fire-fighters positioned a fire nozzle targeting the north/north-east angle.

Around 5.30 pm: explosions led to believe that the elements containing ammonia under pressure gave in (evaporators, pipes, cylindrical tanks etc.).

Around 6.00 pm: fire in the building containing ammonia was contained by the emergency services that were backed by the "Abeille" salvage tug. A site reconnaissance is planned to assess the state of the facilities.

Around 6.10 pm: fallouts of burnt paper were found over several kilometres in the city of Le Havre.

Around 6.12 pm: a laboratory measured air pollution levels and the results obtained were negative.

Around 6.35 pm: upon the request of the inspection authorities of classified facilities, a third party was called to estimate the range of the toxic effects from two scenarios:

- Immediate release of 5 tonnes of ammonia: Z1 = 20 m et Z2 = 450 m
- Continuous release at a rate of 30 kg/s : Z1 = 170 m et Z2 = 1,450 m

(where Z1 is the zone of lethal effects (1% death) and Z2 is the zone of significant effects)

A second "Abeille" vessel and fire nozzles remained as a precaution near the building housing the refrigeration units.

13 deluge guns and 5 large nozzles fought the flames on two other warehouses that caught fire. The fire was contained but the problems related to the fumes required toxicity measures to be taken. A public information campaign was conducted.

Around 6.55 pm: Subsequent to site reconnaissance carried out by fire-fighters, the following elements were brought to the notice of inspection authorities of classified facilities:

- The high-pressure tank of the ammonia unit was full and isolated (as well as the high-pressure circuit).
- The two low-pressure cylindrical tanks were partly isolated and still contained ammonia; fluid outlet pipes and evaporation return circuit could not be accessed.

Around 7.10 pm: a CMIC squad carried out measurements at six different sites in the city. The police ensured patrolling of the warehouse and the fire-fighting operations came to an end.

Around 7.30 pm: the results of the analysis carried out by the CMIC revealed no problems.

Around 8.00 pm: an information point involving the local media is organised for the public.

Around 9.00 pm: five to six fire nozzles, an oceangoing tug, and a crane were still fighting the last fire areas. The equipment was maintained in place overnight.

The archives continued to be quenched on the 20th August with deluge guns placed on the consumed archive piles whose temperature at the centre continued to be very high.

The three ammonia tanks were emptied and made inert on 22 and 23 August under the supervision of fire-fighters.

The fire-fighters finally declared the fire extinguished on 29 August.



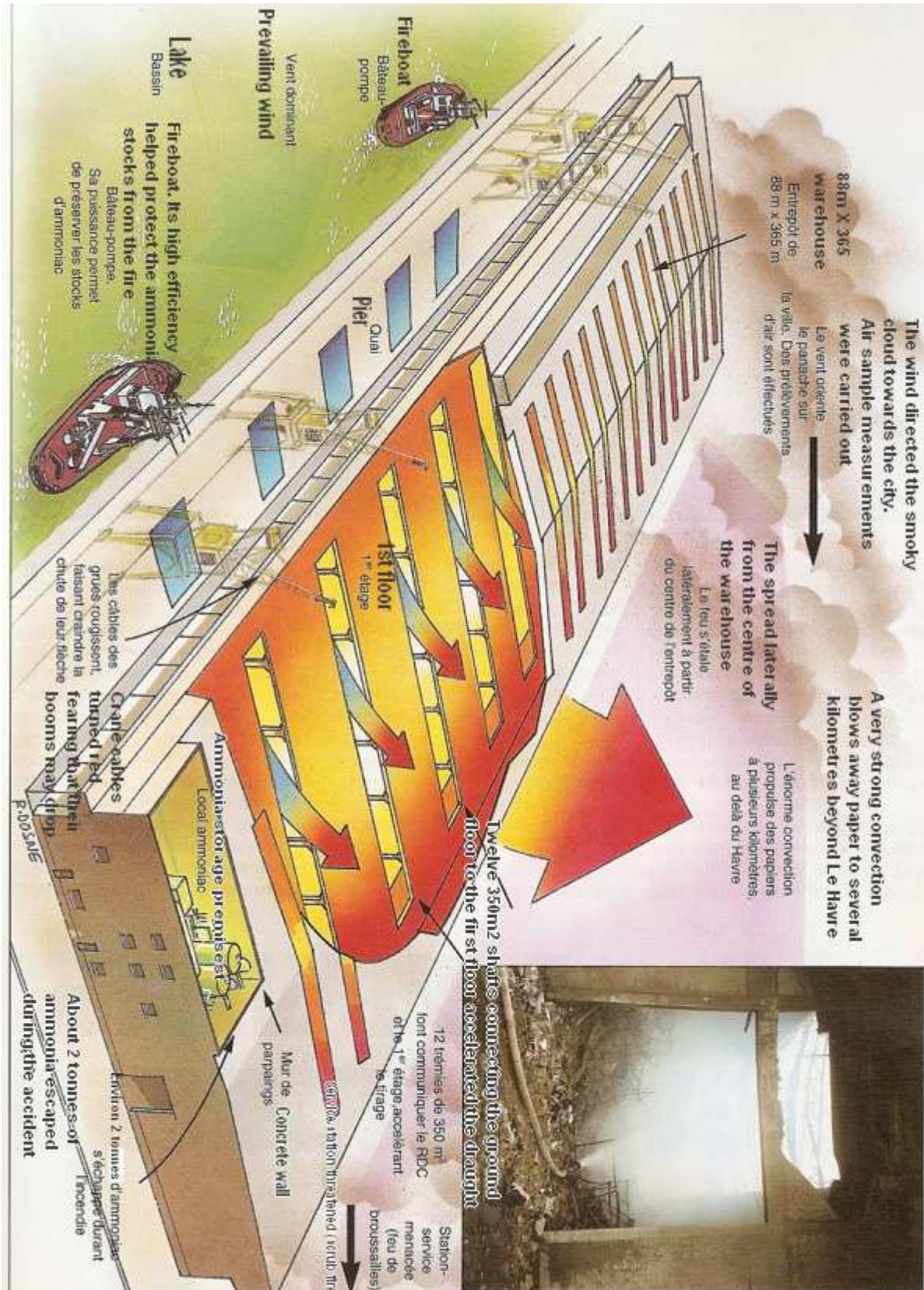


Illustration by René Dosne, published in the "Face aux Risques review, no. 337, November 1997.

The accident had several consequences:

Human casualties

A fireman was injured during the fire-fighting operations.

Material damage

The warehouse, several archives as well as the cooler's internal refrigeration network in shed 78 were destroyed by the fire. The fleeting odour of ammonia observed around 5.00 pm could have been due to the damage suffered by a part of the cooling systems.

In the ground floor, a coach, several power lift trucks, two trailers and several other devices were burnt to a cinder.

Atmospheric release of ammonia:

2,454 kg of ammonia was recovered after the refrigeration units were emptied. Two tonnes of ammonia were estimated to have been wasted during the fire.

The European scale of industrial accidents:

By using rating rules applicable to the 18 parameters of the scale officially adopted in February 1994 by the Member States' Competent Authority Committee for implementation of the 'SEVESO' directive on handling hazardous substances and in light of the information available, this accident can be characterised by the four following indices:

Matières dangereuses relâchées		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conséquences humaines et sociales		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conséquences environnementales		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conséquences économiques		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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

The "dangerous materials released" index is rated at 3 due to approximately 2 tonnes of ammonia released from the evaporators of the refrigeration units (parameter Q1).

Level 1 is attributed to the "human and social consequences" index as one fire-fighter was injured during rescue operations (H5 parameter).

The "environmental consequences" and "economic consequences" index were not rated due to lack of information.

THE ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

An act of malicious mischief is said to have triggered the accident. According to the press, the initial blaze was observed in one of the warehouse shafts at the centre of the building by an employee.

ACTION TAKEN

A specific operating procedure will be followed to empty the refrigeration units to take into account the problems arising from the fire in the warehouse (accessibility, support, etc.). The operation will be spread out over 2 days from Friday 22 August to Saturday 23 August.

Scaffolding has been set up in the east front of the building at the level of the machine room to support refrigerating containers. A crane is used to handle the equipment.

Two distinct networks are needed to empty the equipment depending on the pressure conditions in the different capacities. The tanks were degassed in water-filled containers. After the emptying operation, the entire unit was swept with nitrogen to flush out ammonia and make the equipment inert.

Several safety precautions were implemented during the operation:

- by fire-fighters:
 - monitoring using ammonia detectors
 - a team on stand-by duty to close the sectional valves in the event of an accidental leak and evacuate the present staff
 - hydraulic equipment to form a water curtain in the event of an accidental leak

- bar the operator:
 - identifying the sectional valves and informing the fire-fighters
 - securing equipment by closing all valves at the end of each operation.

Access to the zone around the intervention site was inspected.

The emptying operations were carried out smoothly. The containers were stored on a specialised platform duly authorised for this activity while waiting to be collected by a sub-contracting company.

The building was never used again after the accident.

LESSONS LEARNT

The accident confirms that extinguishing fire in large warehouses lacking sufficient fire protection partition is rather problematic and requires a significant amount of resources.

The considerable heat flow resulting from the combustion of 10,000 m² of surface area was enough to ignite a scrub growth at 200 metres.

Furthermore, the presence of refrigeration units can complicate rescue operations and result in a risk of explosion (BLEVE of storage capacities, equipment or pipes containing liquefied gas under pressure) and toxic emissions (oxides of nitrogen, ammonia or halogenated derivatives arising from combustion depending on the refrigerant used).

Moreover, this accident underlines the importance of isolating refrigerating machines storing inflammable material from fire in an area separate from the ground floor so that this sensitive equipment can be protected and accessed to isolate their cooling circuits in the event of a fire.

The press information campaign conducted on the day of the accident perhaps provided the much awaited answers to the residents.

Accidentology records several cases of warehouse fires:

ARIA 13548, archives warehouse fire in Roye

ARIA 18379, fire in Marly la ville

ARIA 22442, fire followed by water pollution at the Port of Antwerp

ARIA 29687, toxic emission in warehouse storing frozen foods in Nemours

ARIA 34104, fire in a refrigerated warehouse in South Korea

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