

Toxic leak in a dairy

August 29, 2001

Saint-Saviol – [Vienne]

France

Toxic release
Food industry
Refrigeration
Ammonia
Organisation
Training
Work
Circuit identification

THE INSTALLATIONS IN QUESTION

The company and the administrative context:

The Saint Saviol dairy, which employs 110 people, specialises in the manufacture of soft cheese (camembert...).

The plant is located in a very rural area within the *commune* of Saint-Saviol, roughly sixty kilometres (37 miles) south of Poitiers in the *département* of Vienne: the nearest home is more than 100 m from the facility, with others more than 200 m away, including Château de Leray (a listed 12th century *château*) to the northeast.

The dairy is a registered installation subject to authorisation, and inspections are performed by the veterinary services. A Prefectoral Order of July 11, 1990 regulates its activities.

Refrigeration installations are not authorised. In July 1999, following an incident on the ammonia system (NH₃), the inspector reminded the operator of the regulations, requesting that he rectify the plant's declaration if the quantities of ammonia used exceed 150 kg. The operator took no action in that respect.

The installations concerned:

In August 2001, the dairy was operating a water chiller installation that was located within the immense 4,000 m³ (50x20x4) facility. This facility was not used exclusively by the dairy.

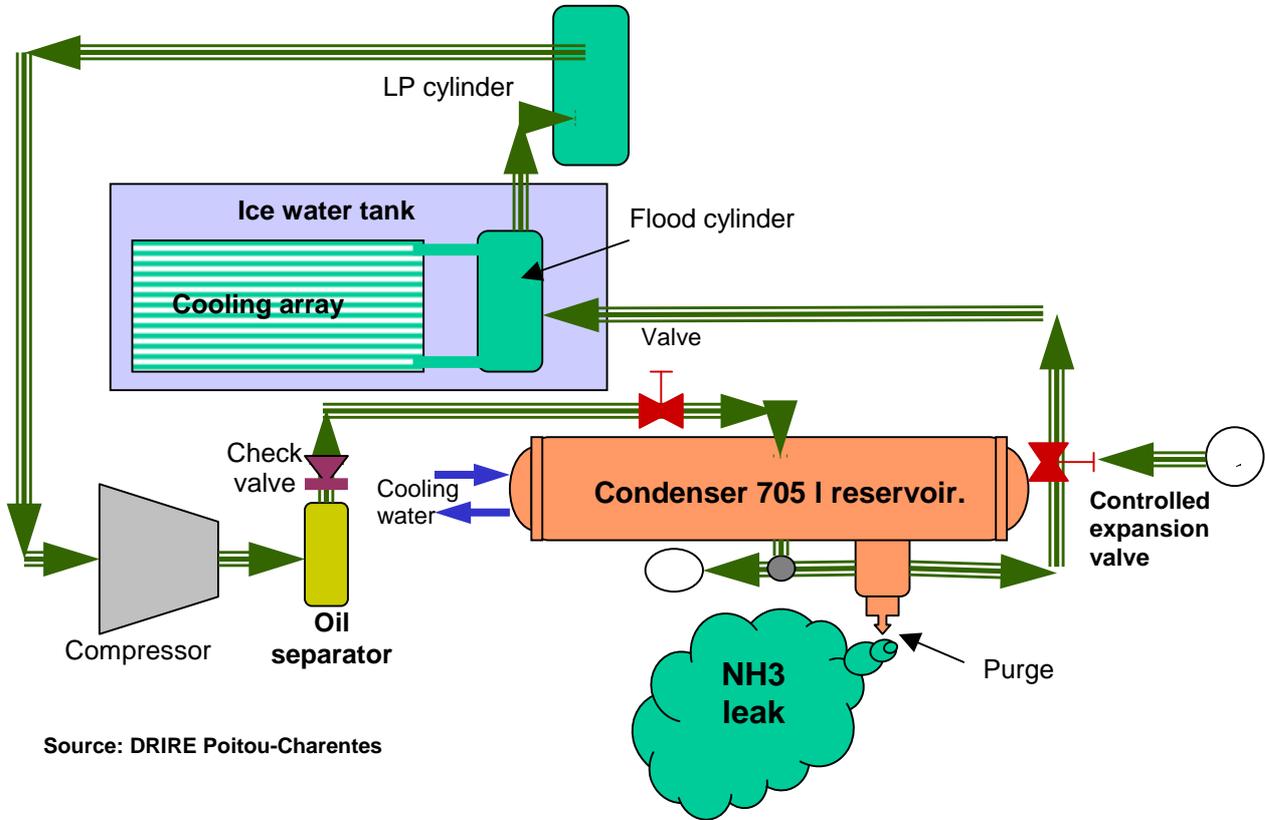
The installation consisted of 3 independent NH₃ circuits of 1 ton each, connected to a large ice tank, into which water flows to cool down the pipes containing NH₃ at – 10 °C, for plant requirements.

Each circuit includes a compressor, a multipipe condenser, a system of buffer cylinders and an ice tank used as an evaporator (cooling array).



Source : DRIRE Poitou-Charentes

NH₃ (a toxic and flammable gas) is used in a closed circuit (Carnot cycle) from a hot reservoir (the condenser), in which it changes from a gas to liquid at ambient temperature (20 °C, 8.5 bar) toward a cold reservoir (the ice tank) where it changes back into a gas (- 10 °C, 3 bar), via the buffer cylinders downstream from the condenser and the compressor upstream.



Source: DRIRE Poitou-Charentes

Heat is exchanged in a multipipe condenser for each circuit where the NH₃ condenses in contact with water coils to which it releases its latent heat of vaporisation. In this installation, the condenser also acts as a NH₃ tank.

A level measurement, with a built-in floater, controls the opening and closing of the upstream expansion valve which allows the NH₃ to be transferred from the condenser to the buffer cylinders and the evaporator, depending on the contents of the condenser.



Source : DRIRE Poitou-Charentes

THE ACCIDENT, ITS BEHAVIOUR AND CONSEQUENCES

The accident:

On August 29, 2001, an NH₃ leak occurred at around 9.45 am in the 4,000 m³ chilled water production building. A welding contractor from an external company was working on the cooling water circuit at the time of the accident.

The consequences:

An initial leak of NH₃ occurred, evaluated at 100 kg of liquid; 65 kg collected in a pool on the floor and 35 kg escaped in vapour and aerosol form. Controlled by level detector with a built-in floater mechanism, the upstream expansion valve, which allows the NH₃ to be transferred from the condenser to the buffer cylinders and the evaporator depending on the contents of the condenser, closed normally, although upstream on the compressor side, the circuit was not shut: 500 kg of gaseous NH₃ were released for 4½ hours.

Overall, the leak was evaluated at 600 kg of NH₃. A toxic cloud drifted over and around the site, and a favourable wind directed it away from the few residences located along the periphery of the site. The *gendarmerie* intervened rapidly, and the fire department arrived with the appropriate resources (chemical unit, 30 people, chemical protection suits, and high-output fans).

A nearby road was blocked off. The 2 individuals present in the chilled water production facility were hospitalised as a precautionary measure and the 50 other employees were evacuated. Fans were installed to extract the highly concentrated NH₃ confined within the building.

The plant resumed its activities 2¾ hours later.

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, based on the information available.

The Saint-Saviol accident is characterised by the following indices:

Dangerous materials released		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human and social consequences		<input checked="" 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 600 kg of NH₃ released into the atmosphere represent 0.3% of the corresponding Seveso threshold (200 t), or level 2 of the "quantities of dangerous materials released" index according to parameter Q1 (0.1 to 1%).

Three parameters are used to determine the rating of the "human and social consequences" index: H3, H4 and H5.

Parameter H3 is 0, no deaths occurred as a result of the accident.

Parameter H4 is also level 0, no one was seriously injured.

Parameter H5 is level 1, as 2 employees experienced discomfort and were hospitalised as a precautionary measure.

As a result, the overall "Human and social consequences" rating is 1.

No elements are available concerning the "environmental consequences" index: Env10 to Env14.

Three parameters are involved in determining the level of the "Environmental consequences" rating: €15, €16 and €18.

By default, parameter €15 is rated 3; the amount of property damage within the establishment was relatively low, although the new installation represents an investment of 210 K euros.

Parameter €16 was not evaluated as the amount of the establishment's property damage is unknown.

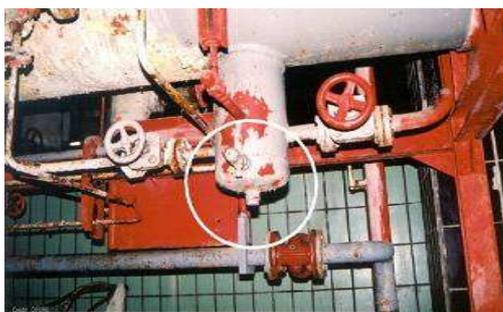
As parameter €18 is very low, it was not evaluated.

As a result, the overall "Environmental consequences" rating is 3.

ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

A welding contractor from an external company had to perform operations on the cooling water circuit on one of the 3 condensers. The bolted retaining flange of the end dome on the condenser's shell was eroded. Water had been leaking for 2 days and management had decided to repair the oxidised part by a local welding operation.

The installation was shut down the day before and the plant's maintenance supervisor drained the condenser's water coil.



Source: DRIRE Poitou-Charentes

Upon his arrival the next day, the welder found the part to be repaired to be still humid and requested a plant mechanic to finish draining the water circuit. The poorly informed mechanic thought that the purge button under the condenser should be used to perform the operation. He loosened it and allowed the welder to perform the additional drainage operation. The purge actually drained the NH₃ from the condenser.

The operator had an insufficient understanding of the circuits and the work had been poorly prepared. The installations had not been equipped in compliance with regulations designed to limit the quantity of NH₃ released.

ACTION TAKEN

Administrative and penal actions:

The Inspectorate noted the establishment's lack of proper authorisation and upon its proposal, the Prefect gave the operator official notice to regularize the situation of its refrigeration installations.

Technical actions:

Once repaired, the damaged circuit was also placed back into service roughly two weeks later.

Following this loss of confinement, which had no effect on the personnel or the external environment, the dairy's management contacted a specialised company to drastically reduce the risk at the source.

The results of the study led the dairy management to invest in a new installation (1M native kilocalories/h) implementing 90 kg of NH₃; the previous installation with three circuits using 1 ton of NH₃ produced less than 400 K native kilocalories/h in all. According to the operator, the overall investment (studies included) was 210 K€.

In addition, the operator decided that all maintenance work on the new installation, which is no longer subject to regulations governing classified installations for environmental protection, shall be performed by a specialised company and not its maintenance crews.



Source : DRIRE Poitou-Charentes

LESSONS LEARNED

These installations were not in compliance with the technical provisions specified in the Ministerial Order of July 16, 1997. In particular, the NH₃ circuits were not identified (this would have no double prevented confusion between circuits during the operation).

The use of the barriers specified in the order would perhaps not have prevented the purge of the condenser, but would have facilitated its dilution by means of a regulatory extractor in the roof.