Flooding of a pharmaceutical plant
01/11/2008
Saint-Germain-Laprade (43)
France

Natural risks / Flooding
Intervention / rescue / Internal Emergency plan
Securing
Water damage
Operating losses
Batch process
Restart

THE FACILITIES INVOLVED

The site:

The site manufactures pharmaceutical active ingredients and is subject to permit with an easement under the legislation of classified facilities to manufacture and store chemicals that are toxic, hazardous to the environment, inflammable and violently react to water.

The plant located in the St-Germain Laprade industrial zone sprawls over 55 hectares including 15 hectares of construction.

St Germain Laprade industrial zone (source: L'Eveil de la Haute Loire)

THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

The flooding:

Following a spell of torrential rains (about 300 mm from 31 October to 2 November with a 3-hour extremely heavy downpour), insufficient draining of the water from the catchment area housing the industrial zone caused flooding. The water level in the entire site reached 20 cm to 1 metre.

Since manufacturing was underway, the staff sounded the alert even before rise in water level in the plant.

The operator triggered the internal emergency plan (POI) on Sunday 2 November around 4.00 am and set up a crisis management division comprising 6 units (intervention, communication, engineering, information, operation and logistics). The operator deployed significant resources to raise or evacuate the equipment and material, keep the most important (from a safety and financial standpoint) chemicals away from water, stop manufacturing processes along with a safety fold back of equipment (safety stand-by phases identified in the safety cases of chemical reactions except for a reactor being heated which had to be cooled before shut down) and plan out power cuts before the water could flood sensitive equipment.

In the event of an emergency, each reactor could be safely folded back by pressing on the automatic shut down button. This solution was not used as a shut down option to avoid any impact on the quality of products in the reactor and enable an easier start. Only 5 out of the 12 inverters could be shut down before the rise in water level. The 7 others had to be replaced but had no negative impact at the time of the incident.

The group operating the Saint Germain Laprade site had seen two other cases of equipment fold back on account of flooding of a pharmaceutical active ingredients manufacturing unit: at Saint Germain Laprade in 2003 for less than 24 hours and in the USA.

The staff present onsite included:

- Before the incident: 12 people
- After triggering the internal emergency plan: 30 people
- Sunday 2 November: 50 people from the plant + 10 people from outside companies
- Night of 2 to 3 November (from 11.00 pm to 6.00 am): 7 people from the site
- Monday 3 November: 150 people from the plant + 55 people from outside companies
- Then 200 to 220 people including over 30 electricians and equipment technicians

Since the leak detectors especially gas indicators were not functional due to the power failure, the staff patrolled the site performing manual measurements of gases, listening to strange noises and watching out for any possible incidence of heating or leaks.

Additional resources were called in: a truck and a power lift truck capable of working in wet environments to move objects. Two high-speed pumps (850 m³/h) provided by the national civil safety department of the French Home ministry were used to rapidly drain the residual water on Monday 3 November. At around 1.00 pm, the water was drained from the site.

Production facilities, air cooling towers as well as electrical equipment and rotating machines were re-commissioned with precaution and monitored.

Consequences of the accident:

The chemical plant was completely flooded where the water level was between 0.2 et 1 m. Damage within the plant was relatively limited thanks to the prompt action taken by the operator. The flooding however resulted in significant water damage on some equipment or in certain premises (Perimetrical system for the detection of intrusions, changing rooms, laboratory partitions, low-lying equipment, etc.). The operating losses were limited despite the shut down of the plant for several days.

The products stored in refrigerated containers were not impacted despite the lack of power supply to the refrigeration and presented no risk of instability in the event of rise in temperature. Except for 200 g of a laboratory chemical in powder form and 2 to 5 litres of a hydrocarbon compound, no significant amounts of environmentally hazardous product were lost. The basins of the liquid effluents treatment station were not flooded.

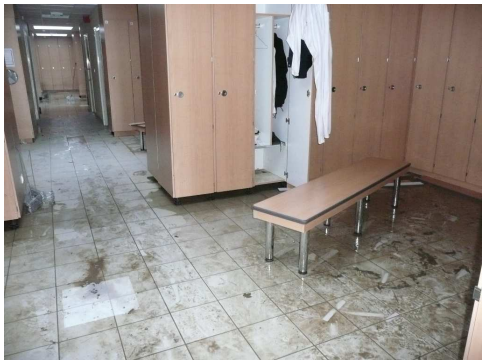
Some wet administrative documents (manufacturing files, product quality certificates for instance) were packed in water tight bags to be recovered using cryogenic treatment.

Preparation of wet documents in plastic bags for cryogenic treatment

The 4 thermal motor-driven pumps for fire protection including the starter batteries were not affected by water due to the high-level storage condition laid down by the insurer. However, automatic start up was not possible due to the power cut.

No incidents of pollution were observed. The loss of identified hazardous material or pollutants was rather low: 5 l of hydrocarbons and 200 g of chemical powder in the laboratory.

Changing rooms during flood



Changing rooms after flood

The European scale of industrial accidents:

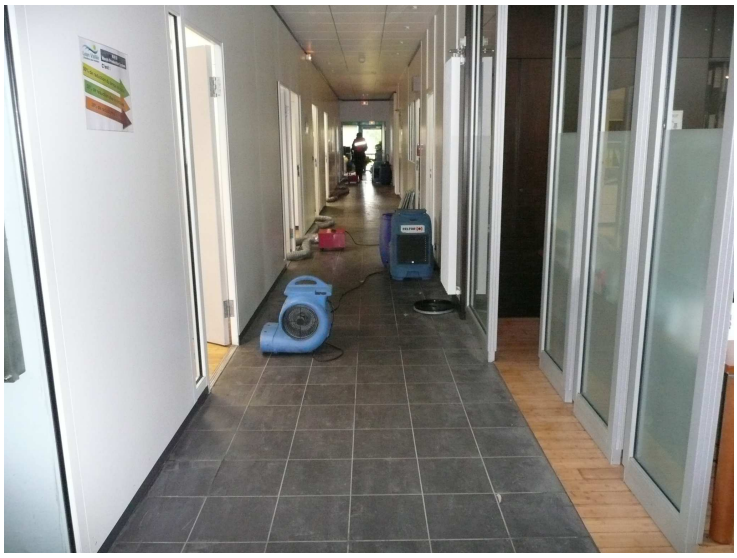
By applying the rating rules applicable to the 18 parameters of the scale officially adopted in February 1994 by the Member States' Competent Authority Committee for implementing the '*SEVESO II*' directive on handling hazardous substances, and in light of the information available, this accident can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

Dangerous materials released	☐	☐	☐	☐	☐	☐
Human and social consequences	☐	☐	☐	☐	☐	☐
Environmental consequences	☐	☐	☐	☐	☐	☐
Economic consequences	■	■	■	☐	☐	☐

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

Since the flood did not result in any casualties, or environmental damage, the overall level of the "dangerous materials released", "Human and social consequences" and "environmental consequences" remained 0.

The flood resulted in relatively limited damage to the plant and low operating losses thanks to effective organisation and prompt re-commissioning of facilities. The losses were estimated at least 10 m euros in the beginning of 2009, rating the "economic consequences" index at 3.



Drying and dehumidification of premises after cleaning and disinfection

THE ORIGIN, CAUSES AND CIRCUMSTANCES SURROUNDING THE FLOODING

The torrential rains during the previous days resulted in the flooding of the site. The St Germain Laprade zone was not located in easily flooded zone but since the site was located in a natural depression, it was flooded even though the platform was raised from 0.8 m to 1.5 m at the time of construction of the site.

The flood occurred due to insufficient draining of the water from the catchment area housing the industrial zone given the torrential downpour over a short span.

Less intense showers were (no buildings effected) experienced in 2003. The water level reached was 662.2 meters (site platform stood at 662.5 meters). The water reached a level of 663 metres in 2008.

ACTIONS TAKEN

During the fold back of facilities, checks were made to ensure the phase of fold back was in line with the predicted status. The status of each production unit was printed from the control station before cutting off the power supply. The operator had planned to gradually re-commission production facilities with a stronger technical back up team. The equipment was isolated in safety position before the automats were re-started even though the risk of a faulty order was not present as the automats were shut down normally.

The air cooling towers were re-commissioned after the chlorine treatment upon start up in single loop followed by another chlorine treatment upon re-commissioning of their network. Samples were taken to screen for legionella.

The thermal oxidiser for volatile organic compounds was stopped properly. However, it was precisely monitored upon re-commissioning: monitoring vibrations, checks with infrared camera, etc.

Since the electrical equipment and rotating machines were in contact with water, they were scheduled for inspection and treatment by a specialised staff and were more closely monitored for several months.

The risks on account of moisture on equipment that was not directly in contact with water can be ruled out given the presence of water in the premises and the low hygrometer reading.

The effected insulators were taken apart and checked using infrared camera.

Following this incident, the DRIRE (Regional Directorate for Industry, Research and the Environment) ordered a special study on the risk of subsidence, especially the subsidence of land and equipment and requested a follow-up.

The safety studies completed in July 2003 had indicated the risk of rain water stagnation in the site. After the flooding in 2003, the operator has improved the site's water drainage system but no initiative has been taken on public infrastructures.

Even though the prefectoral order dated 25 November 2004 authorised the site's operation, the scenario of "flooding" was not included in the internal emergency plane (POI). As part of the revision of the site's POI, it was planned to take flooding into account However, even though flooding was not provided for in the POI, its technical and organisational modalities were applied by the operator to guarantee the safety of the site and reduce economic losses.

The metropolitan authorities launched a local hydrography study at the end of 2008 for its results to be published in 2009.

A part of the public pits were improved after the floods.

NB: the order dated 24 December 2008 (published in the official gazette JO on 31/12/2008) officially declared the town of Saint-Germain-Laprade to have been struck by a natural disaster on account of the flooding incident from 1 to 3 November 2008.

LESSONS LEARNT

The main lessons learnt from this event as of date include:

- Flooding can occur even in a zone that is not classified as an easily flooded zone.
- Flooding does not necessarily occur due to the increase in the water level: the risk of flooding of an industrial site must be evaluated by taking into account the entire catchment area. This evaluation must also be regularly reviewed to take into account the changes (waterproofing the surface, development of infrastructures, modification of water flow systems, etc.).
- An early alert is crucial to put together the crisis management unit and organise all rescue operations.
- The setting up, organisation and the appropriate sizing of the crisis management unit is of prime importance: a system or a tool to contact the key players of the unit must be available to gather the necessary resources (take into account all updated telephone number).
- Cutting off power supply to electrical equipment before any contact with water is recommended.
- It is important to know the safety fold back stages of the facilities for a safe shut down. Safety facilities are a must as flooding of power or IT lines result in a loss of monitoring and control systems.
- Infrastructures preventing any contact with water (dams or storage at an altitude higher than in all flooding scenarios) must be included in designing areas designated to store chemicals that violently react with water.
- Sensitive products (hazardous products and materials, etc.) and if possible mobile sensitive equipment and important documents must be stored above the maximum predictable water level.
- Raised inverters must be installed as far as possible to avoid any fault in the batteries as even if the batteries can be isolated, thy cannot be “drained” of the accumulated charge.
- It is important to have a detailed list of resources need in the event of flooding, and sufficient equipment for the initial operations and reconnaissance (elevation devices, sealing and absorbing products, boots and hip waders, etc.), as well as a list of companies specialising in cleaning, drying and disinfecting operations. These companies can be contacted at the start of the incident to ensure a return to “normality” as fast as possible.
- Wet documents can be conserved through proper treatment (storage in air tight bags and special cryogenic treatment).
- The onsite presence of equipment enabling intervention in flooded zones such as large-wheeled power lift trucks with exhaust pipes and air vents at higher levels, as well as powerful pumping devices is extremely useful in securing sites and draining the flood water. Especially safety equipment such as fire pumps and their accessories such as starter batteries and their fuel tanks must well above ground level.
- During floods, patrolling must be carried out with a view to minimise accidents or incidents of pollution by taking readings with gas indicators, looking out for strange noises, heating and leaks.
- Electrical equipment can be re-commissioned only once they are dried (in case of equipment not having been in contact with water and consequently showing a low hygrometer reading, it seems useful to monitor the hygrometry especially during hot season or in a hot zone).
- Insulators submerged in water or wet due to capillarity must be taken apart for examination and replaced if needed. In addition, they must be monitored after re-start using an infrared camera, etc.
- The chances of a faulty order upon re-start of facilities (especially automats) must be examined. Safety fold back may be planned to counter such a risk.

- Production restart mode must be precisely defined: identification of the dangerous characteristics of reaction media, analysis of risk of clog or deposit formation or product accumulation in manifolds and pipes leading to a risk of mixing of incompatible substances, a re-verification procedure similar to one initiated subsequent to a significant modification, reinforced technical supervision, etc.

- Electrical equipment and rotating machines must be even more closely monitored by qualified staff for several months after the incident.

- Air cooling towers require special procedures before restart (emptying after shutdown over long periods and high temperatures or water in the circuit, disinfection, screening for legionellla upon start up, etc.)

- After draining the flood waters and drying the ground, an analysis of the risk of subsidence, especially differential subsidence may be required to prepare follow-up.

Lastly, with the climate changes, exceptionally intense rains can be expected in the forthcoming years. Will the current standards based on 50 mm of rainfall over 2h suffice in calculating the run-off?

Quick overhaul of facilities (drainage of water, cleaning, drying, tidying up)