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Introduction of frequency in France following the AZF accident

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In France, regulations regarding risk prevention and risk management are the result of more than 200 years of legislation, the evolution of which has often been consecutive to industrial accidents. Two years after the industrial accident of AZF (French initials for AZote Fertilisant), a new law was introduced on July 30, 2003 which described both prevention and repair of the damage caused by industrial and natural disasters. Since then, regulations have been made considerably tighter and the entire approach towards risk assessment has changed.

This law has developed very interesting tools for risk assessment and risk management (some of which are unique worldwide) and has initiated the use of frequency and probability in the French system. Better information to the public, stronger regulations, new methodology for safety reports, over-hauling of land-use planning and improved accident analysis are some of the mainstays of the law.

Regarding the introduction of frequencies and probabilities, as operators in France are free to choose the methodology of probability assessment, it is interesting to review the different methodologies used by operators, with their advantages and disadvantages.

In the light of these elements, France's National Institute of Industrial Environment and Risks (INERIS) has developed a methodology and tools aiming at helping both operators and authorities in the assessment of accident probabilities. This methodology focuses on installation characteristics. However, to deal with the lack of input data, tools are developed to build up available generic data regarding loss of containment, initiating events, safety barrier failure rates and root causes distributions.

Six years after the law of July 30, 2003 was passed, it is now possible to highlight the challenges and improvements brought about by the use of frequency and probability in risk assessment and policies developed as a result.

1. Lessons learned from the AZF accident

1.1. The AZF accident

The AZF factory belonged to Grande-Paroisse (company owned by the TotalFinaElf group). At the time of the accident, the factory had 469 employees and a turnover of 100 M€. The factory, located 3 km from the centre of Toulouse (France – 750,000 people in 2001) and surrounded by an urban environment, produced fertilizers and a variety of chemical products.

1.1.1. The accident

On September 21, 2001, at 10:17 AM, a huge detonation occurred in the nitrates area of the factory. The explosion was felt up to 75 km and was compared with an earthquake with an intensity of 3.4 on the Richter scale. An analysis of the consequences has led to estimate a TNT equivalent between 20 and 40 tons (Barthélémy, Hornus, Roussot, Hufschmitt, & Raffoux, 2001). Windows broke up to 7 km and more than a thousand buildings were destroyed.

After the explosion, important clouds of dust and red fumes containing nitrogen oxides and ammonia were emitted.

1.1.2. Human and social consequences

The accident left 31 people dead: 21 on the AZF site, 1 on a neighbouring factory and 9 in the vicinity of the site. Thousands of people were hospitalized (the Haute-Garonne Prefecture counted a total of 2442 people as of 17 October 2001). The observed pathologies were mutilations, explosions of eardrums and pleura, bruises on spleen and liver, as well as fractures and wounds due to the blast wave, the falling-down of structures, broken glass or projections….

For thousands of people, the AZF accident was a major traumatic experience. Approximately 5000 people consulted their general practitioner for acute post-traumatic stress during the first few

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days after the disaster (INVS, 2002). According to experts, these numbers are underestimated as they only take into account the individuals who sought medical care. The explosion was responsible for psychological problems (depression, anxiety…).

1.1.3. Environmental consequences

The explosion destroyed some of the tanks containing ammonium nitrate and led to nitric acid leaks. Nitrogenous and ammonia releases polluted the Garonne river and entailed a fish mortality.

1.1.4. Economic consequences

The AZF plant and the neighbouring factories were destroyed. About 1300 firms (hiring approximately 21,000 people) were severely impacted by the accident (Dechy & Mouilleau, 2004). The consequences were also dramatic on roads, and public buildings such as schools, colleges, hospitals…. All in all, 25,000 dwellings were damaged, 11,180 of which were severly damaged (ARIA, 2007). More than a thousand were completely destroyed and more than 1200 families had to be rehoused in emergency after the disaster.

Insurance companies appraised the overall economic consequences up to 2 billions € (ARIA, 2007).

1.1.5. Emergency response

The external emergency plan was activated. A crisis centre was installed within the establishment. In total, 1430 firemen and military men, 950 policemen, about 50 doctors, 32 nurses and 80 emergency medical technicians were called up (ARIA, 2007).

A security perimeter was set up within a 500 m radius. Many buildings and schools were evacuated. In the vicinity of the site, the air, railway and road traffic was entirely stopped.

1.1.6. Causes and circumstances of the accident

Downgraded nitrates were stored in the shed 221 and were transported from different parts of the factory by subcontractors. At the time of the accident, that shed held between 300 and 400 tons of ammonium nitrates. The final legal expert report concluded that it was a chemical accident, due to an accidental combination of sodium dichloro-isocyanurate (SDIC – a product used for water treatment) and ammonium nitrate, causing the explosion. The operator has always contested this theory.

1.1.7. Legal action

Grande-Paroisse (as a legal entity) and the plant manager were charged with involuntary manslaughter and wounding.

The investigation gathered up to 140 policemen (judicial police and forensic and technical police laboratories) and 40 legal experts and lasted more than five years. The four-month trial ended on July 1, 2009 and the verdict is due on November 19, 2009.

1.2. Deficiencies identified

A thorough analysis of the accident has led to identify some deficiencies:

- The safety report of the AZF factory did not take into account the downgraded ammonium nitrates store since it was considered as less dangerous (because of the smaller quantity stored). As a matter of fact, the safety report did not describe each possible accident scenario.
- Urbanization has considerably spread out in the vicinity of the site since the launching of the chemical activities. At the time of the accident, the chemical site was surrounded by business parks, hospitals, dwellings….
- People living around the industrial site were not perfectly aware of the potential risks of such an establishment.
- The ammonium nitrate storage facilities were not directly managed by the AZF company but by a subcontractor, whose knowledge of the products and the site could sometimes be incomplete. In addition to the 469 AZF employees, 80 people regularly worked on the site and were hired by nine different subcontractors.

As a consequence, the French government clearly stated the need to reassess the whole approach of risk analysis and land-use planning and also to improve the information to the public and the consideration of subcontractors.

1.3. The law of July 30, 2003 and its mainstays

As a starting point, it is interesting to recall that in France, regulations regarding risk prevention and risk management are the result of more than 200 years of legislation, the evolution of which has often been consecutive to industrial accidents. The accident of the gunpowder factory that occurred in Paris in 1794 led to more than a thousand casualties. It brought about the imperial decree of October 15, 1810 about the factories that were sources of nuisances or risks. Three categories of factories were then defined (hazardous, insalubrious or causing inconvenience) and the first elements of land-use planning were enacted. This decree as well as the law of December 19, 1917 regarding “dangerous, unhealthy and inconvenient establishments” have established the fundamental rules for risk prevention and land-use planning in France.

The law of July 19, 1976 has modernized and updated the monitoring of classified installations according to the risks or nuisances that they generate. On the European level, the council directive 82/501/EEC on the major accident hazards of certain industrial activities – so called the Seveso directive – in 1982, laid the bases of a common policy for the prevention of major industrial accidents. The “Seveso II” directive, in 1996, introduced important changes and new concepts, such as safety management systems, emergency plans and land-use planning.

Six years after the publication of that directive and two years after the AZF accident, the law of July 30, 2003 was introduced. It does not only deal with industrial disasters but also with natural disasters, as a response to floods that happened in France (caused by the rivers Somme, Gard and Hérault).

The law of July 30, 2003 regarding the prevention and repair of the damage caused by industrial and natural disasters, along with government actions, has enabled a focus on the following priorities:

- *Increase of the number of inspectors and improvement* of their training curriculum for a better regulation of the classified installations and for a more efficient control force: between 2001 and 2008, the number of inspectors increased by 40%. In 2009, there are approximately 1400 inspectors in France, including 400 to 500 specialized in Seveso establishments. Since 2005, the training curriculum for inspectors has also been expanded and improved. Within the first 6–8 months after the taking up of their position, inspectors have to attend two one-week courses about the legislation and regulation concerning industrial plants and specific regulations regarding water and air emissions, wastes, noise nuisances… Then, over the course of the first three years, nine general courses about industrial risks, crisis management, soil contamination, etc. have to be taken. For Seveso inspectors, more specialized courses about the safety report, safety management system, land-use planning… are highly recommended. Moreover, the inspectorate has committed to inspecting every year each of the 2000 high priority establishments (including the Seveso