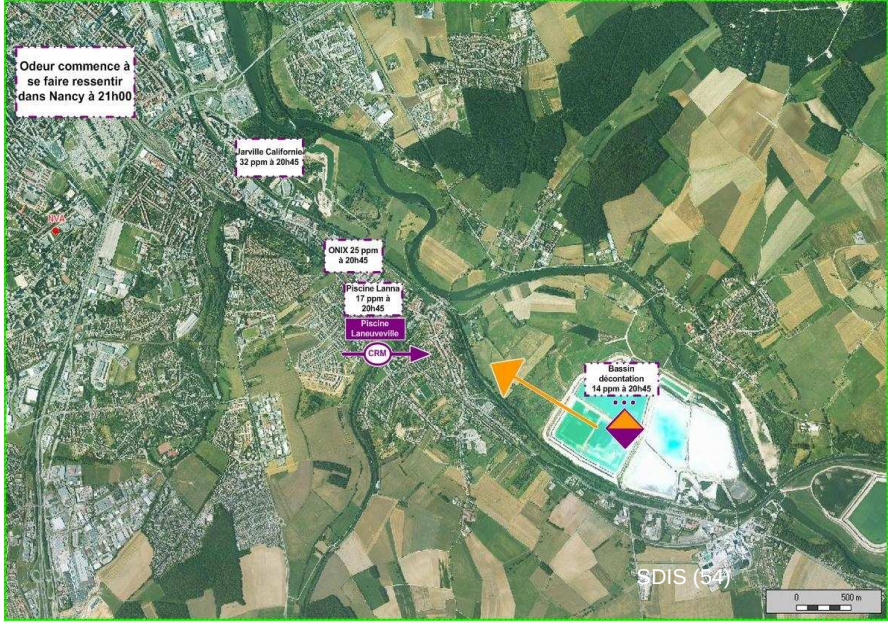
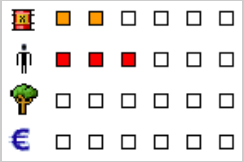
Crisis situation catalysts



21 Ammonia odours in the city

ARIA 34027 – 20/12/2007 - 54 - LANEUVEVILLE-DEVANT-NANCY

23.99 - Fabrication of other mineral, non-metal products



Within a chemical plant producing sodium carbonate, 45 m³ of ammonia-laden water at a concentration of 22 g/l accidentally spilled into the site's 23-ha settling basin. The ammonia cloud (NH_3) that formed by means of vaporisation above the basin did not disperse as a result of unfavourable meteorological conditions (i.e. -4℃, fog, little wind), but instead drifted towards the city of Nancy between 7:30 and 10:00 pm. A pungent odour upset the neighbouring residents of Laneuville-les-Nancy, Jarville-Vandoeuvre and the southern part of the Nancy Metropolitan Area; the police and fire services recorded some 600 phone calls during this period.

The prefecture set up a crisis response unit. Radio messages were broadcast informing the population to remain indoors. Some one hundred fire-fighters were deployed to perform toxicity measurements within the affected zone and inform the local population. The NH_3 concentration, which reached levels of 50 to 60 ppm at the point of toxic release, was measured between 10 and 32 ppm outside the plant (NH_3 Average and Maximum Exposure Limits of 20 and 50 ppm). The state of alert was in effect until 11:30 pm.

The ammonia-laden water stemmed from the liming of ammonium chloride during production of the sodium carbonate. It is a manufacturing by-product typically distilled in order to separate the gaseous NH_3 recycled as part of the process from the saline water transferred into a settling basin prior to discharge into the natural surroundings.

The saline effluents were loaded with impurities (gypsum) that precipitated into the solution intended for distillation and encrusted the devices and piping. The day of the accident, a gypsum crust broke loose when starting up a distillation unit and plugged the suction chamber of the pump assigned to discharge the saline effluent to the settling basin. During the subsequent unscheduled maintenance visit, an operator shut off the distillation columns at their outlet while forgetting to stop the liquid supply line on one of them. After removing crust accumulation on the installation, the column that had gradually filled with undistilled ammonia liquid, due to a liquid load pressure in the column exceeding the vapour pressure, opened on the discharge pump at the basin and the undistilled liquid poured into the basin for 15 min.

Several remedial actions were carried out following the accident, including: improvement of the operating procedure (greater detail added), training of onsite teams in implementing this new procedure, installation of NH_3 sensors at the distillation column outlet, and lowering of the sensor alarm threshold at the level of the settling basin.

Crisis situation catalysts

The event of limited severity presented above relates a wintertime dispersion of malodorous ammonia vapours, yet the concentrations involved were small and the incident produced only a very low level of toxicity. Such a pollution episode however raised great concern among the neighbouring populations, who remained uninformed of the incident for several hours.

Objectively speaking, all crises can be related to two main causes:

- The first one is technical. This cause pertains to the operation of hazardous processes and with it the unavoidable possibility of incidents and accidents. Even when qualified as "residual" after being minimised by appropriate technical and organisational measures, risk can never really be eliminated altogether. This fact relates not only to the potential hazards present within installations, but also to the capacity for human organisations to identify positions on the accident causal chains and to act before basic deficiencies combine and thrust the system onto the accident critical path. Moreover, consequences may be exacerbated by the proximity of vulnerable elements (ARIA 4225, 4998, 12831, 17265, 22375, 23155, 23866, 23936, 26880, 29687, 31312, 32163, 32806, 33669, 33828, 34733, 34828, etc.);
- The second cause is social and pertains to the gap in comprehension by civil society of risk prevention limits and their corresponding rules.

The population's concerns and the crisis that follow an accident are generally all the more intense than the perception of the preliminary risk analysis by prevention actors is quite different from the understanding by civil society of the proven or feared consequences of an accident.

Several factors influence the acuteness with which civil society perceives accidents:

- Misconception or insufficient awareness of the potential for serious accidents, which are often qualified as improbable or only slightly probable by the process actors;
- A sharp contrast between the routine of day-to-day operations and the magnitude of unexpected consequences due to the accident (Mexico City, Bhopal, Enschede, Toulouse, ARIA 4225, 12831, 20493, 33516…), whose geographic extent in some cases crosses national boundaries (Chernobyl, ARIA 17265, 31312, 32679, 33740…);
- The concentration over a short time period of a high number of casualties (Toulouse, ARIA 26002…);
- Exposure to children or the less able-bodied (Seveso dioxins, ARIA 9539, 26002, 31803…), the fear of inducing long-term effects (ARIA 13050, 29977…) or effects for future generations (Seveso, PCB fires…);
- Significant consequences, whether proven or anticipated, immediate or delayed for both the environment (ARIA 12831, 17265, 27146, 30269…) and economy (ERIKA, ARIA 1671…);
- A succession of similar accidents over a short period or implicating the same facility (Tricastin, ARIA 4303, 17265, 23839…);
- Anxiety related to the length of time required to evaluate risks caused by the accident (legionella, dioxins, ARIA 3536, 13050, 15513, 20493, 21990, 23182, 25231, 34893…);
- The Mis-appreciation of materials (PCB, dioxins…), their properties, the relatively unconventional techniques employed (chemical industry, nuclear industry, etc.), the associated risks and accidental mechanisms also contribute to increasing the level of public concern ('Seveso' hazards, legionella…);
- A source of the specific event difficult or impossible to identify quickly: Legionnaire's Disease… (ARIA 26002, 23195, 25551…);
- The ignorance or poor understanding of the set of rules governing risk prevention (ARIA 33516…);
- The lack of confidence in dealing with entities assigned to manage risks (Seveso, ARIA 29977…);
- Difficulties involved in preventing risk and protecting against accident consequences (Toulouse, ARIA 12831, 17265…);
- Long or arduous emergency interventions (ARIA 4998, 13099, 13473, 20436, 21199, 21385, 22375, 23030, 23839, 30103, 31312, 32163, 32215, 32593, 33862, 34893…);
- Difficulties involved in mitigating consequences and in restoring a normal situation (Toulouse);
- An inadequate amount of explicit information on the possible consequences of an accident / incident, delay in generating this information relative to the various points of view expressed in the media or on the Internet (ARIA 26002, 30269…);
- The type and extent of media coverage (Seveso, Toulouse, ARIA 29977…);
- Insufficient information circulated during normal operating periods on prevention limitations.

Without waiting for the serious accident to happen, the occurrence of incidents provides the opportunity for a well-balanced dialogue to take place with the society by means of incorporating both the negative and positive elements, such as anomalies and the set of adopted remedial measures. These exchanges must not be overlooked, given that the opportunities to dialogue with civil society on prevention limits are not very frequent: publication of hazard studies, CLIC (local information and dialogue committees), PPRT (technological risk prevention plans), public consultation and preventive information on external emergency plans.

The immediately released information on incidents taking place within 'SEVESO'-establishments (ARIA 33669, 33828, 33862, 33899, 34281, 34384, 34437, 34499, 34627, 34828…) offers a step in the right direction and may contribute to gradually narrowing the gap in understanding that exists between process actors and the public on the efficiency of prevention measures and their limitations, while promoting the development of shared monitoring.

Additional references (detailed accidents):

- ARIA 29687_nemours_2005 / Ammonia leak within a refrigerated warehouse
- ARIA 23839_chalampe_2002 / Long-lasting cyclohexane leak
- ARIA 13050_amberieux-en-bugey_1998 / Fire in a meat curing plant
- ARIA 4225_la-voulte_1993 / Derailment of a train transporting fuels
- ARIA 3536_jarrie_1992 / Fire/explosion in a production facility using oxygenated water

The accidents whose references are not underlined may be consulted at:

www.aria.developpement-durable.gouv.fr

ARIA 4225 - 13/01/1993 - 07 - LA VOULTE-SUR-RHONE

49.20 - Rail freight transport

Subsequent to an axle failure, 7 rail tanker cars in a convoy of 20 cars derailed; 4 were heavily damaged and spilled their contents. A raging fire then broke out. One railcar suddenly burst open and exploded, with a fireball forming 15 to 20 min later. Streams of ignited fuel spread on the ground and reached the closest dwellings located 20 m away along the lower slope of the rail tracks, creating a succession of explosions in the sewer system. Nearly 1,000 people had to be evacuated during the night within a 600-m safety perimeter. Total damages amounted to over 70 million francs. Some one hundred residents were relocated throughout the pollution cleanup period.

ARIA 4303 - 22/02/1993 - GERMANY - FRANKFURT

21.10 - Manufacturing of basic pharmaceutical products

An operator turned a stirrer back on too late following a facility inspection. A runaway reaction then caused the pressure in a reactor to rise, in addition to discharging (via the safety valves) 2 tonnes of ortho-nitroanisol, 5.5 tonnes of methanol and 0.2 tonnes of soda, plus other emissions. The fallout of chemical products polluted several hectares of soil. Many dysfunctions were recorded during post-accident crisis management. The decontamination steps were valued at 50 million francs. This accident and others that occurred over the ensuing weeks in the company and its subsidiaries led to a major safety inspection programme of chemical facilities across the State of HESSE.

ARIA 12831 - 25/04/1998 - SPAIN - AZNALCOLLAR

08.99 - Other extraction activities

The dyke of a waste storage basin of a pyrite mine broke over a 50-m length after a landslide; as a result, 4 million tonnes of acidic water and 3 million tonnes of sludge laden with Zn, Fe, Cu, Pb and As (0.3 g/l) reached first the RIO AGRIO River and then the GUADIAMAR River, which overflowed by 200 to 300 m over a 20-km section. This toxic flow threatened the Donana National Park, at the periphery of which emergency crews built earthen embankments. In conjunction with this effort, authorities set up dams to confine the bulk of pollution released to the Entremuros Canal (though overflows still flooded neighbouring agricultural areas). A portion of the pollutants did reach the GUADALQUIVIR Delta, some 80 km downstream of the mine and polluted Gulf of Cadiz beaches. The effluent infiltrated into the groundwater, which constitutes the primary water supply resource for the Park and the city of Seville. The waste contaminated 7,000 ha of pastureland and marshland as well as 3,500 ha of farmland, killing 30 tonnes of fish, tens of thousands of birds (geese, storks, etc.), 220 kg of shellfish, frogs, horses, goats… Several individuals were slightly burned by the acidic water while trying to save cattle. Hunting, fishing and water consumption (for irrigation, potable water pumping, etc.) were prohibited for several weeks. The decontamination operation lasted 8 months, and a total of 5 million m³ of sludge and 2 million m³ of excavated farmland were stored in an abandoned mine. 4.5 million m³ of water held in the Entremuros Canal were treated in a waste-water treatment plant and then discharged into the GUADALQUIVIR River. Authorities implemented a water and soil quality monitoring and restoration plan and, in 2004, undertook a programme to replant vegetation on the contaminated banks. The total cost attributed to the disaster was estimated at 240 million Euros, including all drainage and sanitation work, agricultural losses and authority repurchase of contaminated land. The mine was closed for a full 12 months, forcing layoffs of 500 employees; the mine would be shut down definitively in September 2001. The accident was caused by a 1-m landslide of a 600-m² marl plate 14 m thick on top of which the dyke had been positioned. Several expert reports had previously indicated in 1996 the vulnerability of this clayey subsoil and dyke instability. European legislation on managing mining waste was strengthened after this accident and the one at Baia Mare (ARIA reference 17265).

ARIA 17265 - 30/01/2000 - ROMANIA - BAIA MARE

07.29 - Extraction of other nonferrous metal ores

A 25-m long crack formed on the collapsed dyke of a settling basin for mining tailings. A total of 287,500 m³ of effluent laced with cyanide (115 tonnes) and heavy metals (Cu, Zn) spilled, contaminating a 14-hectare sector and polluting the SASAR River. A 40-km "cyanide wave" swept through the LAPUS, SZAMOS and TISZA Rivers before finally reaching the DANUBE. The cyanide concentration rose as high as 50 mg/l in the LAPUS, 2 mg/l in the stretch of the TISZA running through Yugoslavia (on February 12) and 0.05 mg/l in the DANUBE River Delta, some 2,000 km downstream of the Baia Mare site (February 18). Romania, Hungary, Yugoslavia, Bulgaria and the Ukraine were also affected by the accident. High cyanide concentrations were measured in privately-owned wells, and the health of several individuals was adversely affected after ingesting contaminated water. Water consumption and fishing activities were banned in the zone. Wildlife and vegetation were destroyed over an area extending hundreds of kilometres: 1,241 tonnes of dead fish were recovered in Hungary alone, and thousands of dead animals were found (swans, wild ducks, otters, foxes, etc.). The authorities of countries located downstream were quickly informed and could thus take effective preventive measures, including: dam runoff, notifications sent to all water supply utility operators. Dam design flaws (excessive proportions of fines), poor weather conditions (heavy rains and snowmelt resulting in a rise of the basin water level, and a thorough soaking of dam components causing structural weakening) and organisational breakdowns (absence of effluent transfer measurement procedures) were all causes of the accident. The reasons behind the high fish mortality rate could not be clearly established since a very high quantity of bleach might have been used to neutralise the cyanide. After the accident, the basin operator set up a cyanide waste treatment plant, along with a 250,000 m³ holding basin to collect overflow from the settling basin before neutralisation and discharge into the natural environment. The accidents at Baia Mare and Aznalcollar (ARIA file 12831) have led to reinforcing European legislation on mining waste handling. It should be pointed out that major leaks had already been observed on the dyke two months prior to the accident.

ARIA 20493 - 18/06/2001 - 02 - VENIZEL

17.12 - Paper and cardboard production

A fire broke out around 2:50 am in an electrical utility room at a paper mill. Engulfed in the flames, three transformers emptied entirely and a fourth halfway, dispersing 1.5 tonnes of dielectric containing PCB. A prefectural order motivated by a proposal from the inspectorate of hazardous installations prohibited site access as of the very same day and imposed site decontamination work, in addition to commissioning analyses and a detailed risk evaluation. A total of 96 individuals present at the time of the accident (including fire-fighters, employees, 2 journalists and 7 neighbours) had to undergo epidemiological supervision for a full year. The trajectory of smoke led to delimiting a 2.5-km cone-shaped zone for future monitoring and a ban on consuming crop/vegetable production. About one hundred samples of soot, building materials, soils, water and plants revealed the presence of dioxins and furans. Site decontamination work was performed on both the factory buildings and grounds as well as on the two closest dwellings located 250 m away. Moreover, a plan was adopted to eliminate all equipment containing PCB. The gradual reactivation of installations, 15 days after the accident, was subject to prefectural authorisation, which was granted on the basis of receipts for work and successive expert reports submitted by the site operator. The prohibitions relative to exterior land were lifted 25 days later. The quantity of PCB lost equalled approximately 600 kg (of the 2,800 kg initially included), and the quantity of dioxins emitted was 13 kg. The building that caught fire was completely destroyed, with the amount of these damages estimated at 100 million francs. Fire ignition might have been due to a short-circuit or the poor condition of an electrical component. The "transformer fire" scenario had not been investigated in the safety report, and installation drawings had not indicated the precise location of this type of equipment.

ARIA 26002 - 28/11/2003 - 62 - HARNES

20.14 - Manufacturing of other basic organic chemicals

On November 28, 2003, two cases of Legionnaire's Disease were recorded, the first symptoms of which dated back to the beginning of November. The dates of outbreak of the pathology, which were then staggered over time, revealed two distinct waves of contamination with a total of 86 individuals contaminated, aged between 32 and 92 (of whom 18 died). These cases all broke out within a radius of slightly over 10 km around the city of Lens. The DDASS (local Sanitary and Social Affairs Office) conducted environmental investigations at the homes of patients and within several facilities open to the public. At the request of the DRIRE (Regional Agency for the Environment, Research and Industry), all facilities operating cooling towers within the designated zone were asked to adopt measures to identify the eventual presence of legionella and clean their circuits. On October 15, the operator of a chemical installation specialised in alcohols and fatty acids extracted samples whose results revealed a concentration of legionella at a level of 730,000 CFU units/litre. Following a shock treatment using biocides, analyses 15 days later yielded a concentration of less than 100 CFU/litre. On November 20, another inspection announced that the level of 600,000 CFU/litre had been reached. In light of these results, the chemical plant's cooling towers were ordered to be shut down on November 29. As of December 3, the tower circuits were drained and cleaned. Operations resumed on December 22, and a prefectural decree was issued January 2, 2004 mandating the operator to halt all plant activity once again due to the appearance of a second epidemic wave. At the same time, the Prefect commissioned the DRIRE Agency to extend its investigations, notably by inventorying all cooling towers within the neighbouring 53 towns and imposed the shutdown of several installations (automobile washing stations, food processing activities, refrigerated warehousing, etc.), causing layoffs to hundreds of workers for several days. Even though a similarity was detected between the strains extracted from 23 of the patients and those present in the suspected cooling tower at the petrochemical plant, other sources of contamination could not be ruled out. High legionella counts in the lagoons of this same plant necessitated turning off aerators on January 20. This site's revenue loss would amount to several millions of Euros, corresponding to a production downtime of 14 weeks. A prefectural order authorising reactivation of the towers was issued on March 19, 2004, yet the plant would never operate again.

ARIA 29977 - 01/01/2005 - 45 - GIEN

38.11 - Collection of non-hazardous wastes

As part of the mandatory annual analysis of atmospheric emissions, the operator of a household waste incineration plant received on October 8, 2004 the analyses of samples extracted during the month of August, showing: considerable excess of CO (312 and 664 mg/m³ vs. a threshold of 100 mg/m³) on two processing lines (l1 and l2) and in HCl on the l2 line (571 mg/m³ vs. threshold of 50 mg/m³), along with high values of dioxins (29 and 221 ng/m³) on the two lines. Informed of these results on November 8, the local DRIRE Environmental Agency proposed issuing a formal notice to impose compliance with regulatory thresholds in addition to a monthly monitoring campaign instead of annual tests (January 2005 directives), including: tracking of atmospheric emissions and impact of dioxins within a 5-km radius (analyses conducted on milk from adjacent dairy farms, atmospheric fallout). On January 21, the DRIRE Office received the cross-check analyses of discharges conducted during December: no threshold excess on the l1 line, marked excesses of both CO and HCl (513 and 183 mg/m³) on l2, very high dioxin contents on both lines (21 and 308 ng/m³). On the same day, the Agency requested closing l2 altogether (to take effect on January 24), and ultimately suspending this line (order issued on March 16 upon recommendation of the local Hygiene Office). On February 23, the samples taken in January confirmed the facility's malfunctions and the need to shut l2 down: 1,875 mg/m³ of CO and 680 ng/m³ of dioxins above the previous findings. The enhanced atmospheric emissions monitoring programme indicated a return to normal operating conditions on the l1 line. Monitoring was extended out of precaution and oriented towards ensuring food safety, i.e.: dioxin levels found in the soils, plants, eggs, vegetables, grazing lands and fodder. According to the experts (AFSSA, INVS), these results did not reveal any abnormal level of contamination among the various media nor an exaggerated potential health risk for neighbouring populations: in particular, the rate of dioxins in storm water collector pipes was observed to be low in comparison with typical values, the amounts found in milk were compliant with sanitary standards (which equals 3 pg I-TEQ/g of fat, i.e. the value above which milk is recalled from stores), and high concentrations in eggs from family farms attributable, following a field investigation, to local practices. According to the facility operator, an inadequate level of waste preparation (formation of "clusters", accumulation of iron wires) would explain the poor combustion (resulting in the formation of CO and dioxins). The fluidised bed would have gradually deteriorated. The malfunction of smoke exhaust treatment using milk of lime would explain the HCl contents. Works intended to bring operations into compliance and optimise both incinerator furnaces were undertaken. The plant would start up again 3 years hence (January 2008), and at that time the pollutant discharge measures were compliant with regulatory standards.

ARIA 33516 - 06/05/2004 - 88 - EPINAL

86.10 - Hospital activities

Over 800 patients were victims of radiation overdoses during radiotherapy sessions in a hospital during 2004 and 2005. The overexposure to X-rays caused the deaths of 4 patients, and 20 others were very seriously irradiated. According to a report from the nuclear safety authority, these overexposures stemmed from: a computer data entry error in the dosimetry software used during treatment preparation, lack of personnel training in the use of this software, and a poor software user interface. No traceability of operations could be performed. Machine operators were given no user's guide in French adapted to their day-to-day use. 14 individuals filed a suit following the accident: 4 for involuntary manslaughter and 10 for involuntary injuries.

ARIA 34893 - 15/07/2008 - 68 - GEISPITZEN

35.13 - Electricity distribution

A transformer exploded and ignited at 10:15 am, causing projections around the room and an oil spill that partially flowed into the municipal sewage network via gutters. Neighbours notified local fire-fighters, who were on the scene by 10:30 with their standard emergency equipment. A CMIC unit specialised in chemical emergencies had the fire under control 10 min later using a powder extinguisher. Rescue crews noted the presence of oil on the pavement and in a storm drain manhole that was poorly maintained and clogged; since a risk of overflow was feared, another CMIC unit called in as a backup pumped 50 litres of oil into the manhole. As opposed to the first agents onsite at 11:05, the electricity distribution team did not confirm the presence of PCB in the device that had been operating since 1965. Samples were extracted for analysis, the site was cleaned, and the emergency intervention officially ended at 1:10 pm. For precautionary reasons, doctors examined 15 fire-fighters, 2 witnesses and 2 gendarmes, despite showing no symptoms. A blood test was also administered to each of them the next morning. The presence of PCB was finally confirmed upon the Hazardous Installation inspection at 5:30 pm; the oil contained 89 g/kg of PCB, i.e. a concentration greatly in excess of 50 mg/kg and necessitating the decontamination of equipment. The pumped oil and polluted wastes were transferred and isolated at an appropriate site. In order to prevent against additional pollution tied to PCB, a strip of soil hit by oil spatter was scraped 20 cm deep with transfer onto the same site as the excavated earth and transformer. On July 16, the electricity distribution service performed additional sampling of the polluted pavement surfacing before having it covered with a tarp, while informing the IIC Office of the discovery of an unauthorised white verification tag on the transformer (a yellow tag indicates PCB content, a green one content free), dated 2001 indicating the possible presence of PCB. At IIC's request, dioxin analyses of the soot were carried out on July 17. Since the presence of PCB was unknown at the time of the accident (poor communication between fire-fighters and the site operator), the emergency crews did not take all the effective precautions during their performance onsite: cleaning water discharged into the network, crew members not equipped with adapted protective gear, individuals present on the site (police, neighbours) not removed or evacuated accordingly. Once the presence of PCB had been established, all those exposed to fire smoke received proper care and were placed under medical observation.