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CHAMBRES D'AGRICULTURE
ASSEMBLÉE PERMANENTE

ACCIDENTS AND INCIDENTS IN CATTLE FARMING ACTIVITIES

CURRENT ASSESSMENT AND FEEDBACK ANALYSIS

October 2010

FOREWORD

Within the scope of its missions, the BARPI (Office for the Analysis of Industrial Risks and Pollution) records and analyses all events, spanning near-accidents, incidents and full-blown accidents, involving classified industrial facilities with potential environmental protection impacts. From this perspective, events stemming from the farming of beef cattle, pigs, rabbits, poultry and game birds are reported in the ARIA database. The present analysis is based on 2,686 such events recorded between January 1st, 1992 and August 31st, 2009 in relation to farming activities.

The purpose of this document is to characterise general accident trends, with an emphasis on drawing lessons to assist actors in the field of risk prevention.

1. GENERAL ACCIDENT CHARACTERISTICS

Upon reviewing the range of incidents and accidents involving cattle farming, several observations quickly become apparent:

- In general, farms are especially prone to fires. Among the 2,686 events examined, the breakdown is as follows:

- <u>85% fires</u>
- 16% discharge of hazardous or polluting materials;
- 1.2% explosions;
- 1% of events falling under various headings (animal asphyxiation, accidents involving personal injury or death, flooding, etc.).

- Even though the processes and technologies introduced are rarely highly complex, agricultural facilities make use of hazardous or polluting materials and generate risks of personal harm and environmental damage. Farm employment numbers tend to be lower than those of other industrial production sectors, with as a corollary a less sophisticated risk prevention approach being practiced in agriculture.

- The fire concern varies depending on type of cattle breeding operation, given the different kinds of installations and processes capable of being implemented, although two categories can be distinguished:

- poultry, veal and pork production:
  - frequent presence of an "industrial" type of production approach;
  - large number of animals concentrated over a small space within enclosed buildings;
  - intensive use of energy and equipment: heating, ventilation, feeding, etc.
  - heavy dust accumulation;
  - a building design and layout that incorporate many requirements with respect to lighting, heating, air recirculation or operating devices for animal feeding, ground cleaning, etc.
- beef cattle farming (excluding calves):
  - operating protocol less often inspired by an "industrial" model;
  - a building design and layout typically with fewer constraints to consider;
  - a large amount of space devoted to fodder storage.

- The consequences of accidents in this sector can be extremely serious:

- 48 fatal accidents and 23 other accidents responsible for serious injuries; these are relatively substantial numbers given the limited employment in the agricultural sector;
- farm buildings still often located in the middle of rural villages, resulting in external damage in the case of fire outbreak;
- internal equipment damage is severe and jeopardises durability of the farming operation:
  - loss of a herd, whose genetic specificities may be difficult to substitute (as a result of animal selection/breeding practices over many years, use of rare breeds, etc.);
  - destruction of farm buildings and production machinery.

Accident causes are rarely known with certainty. One of the reasons for this lack of traceability is that information on fires often stems from emergency response services; farmers apparently do not systematically notify the classified facilities inspection authorities when incidents or accidents arise (only 7% of events analysed for this study were reported in facility inspectorate records). Moreover, since property damage from fire tends to be very significant, it is difficult to accurately identify accident causes.

CLOSE-UP

In order to refine this assessment, a more detailed analysis was conducted on a random sample composed of 10% of the 2,686 events extracted from the database. Of the 268 events contained in this study sample:

- the distribution of accidents by type offers the same order of magnitude as the complete set of events, i.e.: 86% fires, 0.7% explosions, 16% discharge of hazardous materials, and 1.5% covering various event headings;

- information regarding the causes or anomalies responsible for incidents/accidents is only available in 13% of the cases, and in most instances it is only piecemeal. The 13% of cases with tangible data can be broken down as follows:

  - design flaws: 11%
  - maintenance deficiencies (inadequate, poorly executed, etc.): 11%
  - operational anomalies: 20%
  - external causes (malicious intent, outside installation or vehicle, lightning, etc.): 11%

  - equipment malfunctions: 51% (in recognising that the most serious causes of equipment malfunction are rarely elucidated)
  - human error: 20%
  - organisational breakdown: 25%.

  - the equipment or operating aspects either responsible for or the suspected cause of these accidents include:
    - LPG or household fuel oil tanks: 20%
    - heating systems: 20%
    - manure pits and ancillary equipment: 20%
    - ventilation/fans: 3%
    - boilers: 3%
    - tanks containing phytosanitary products or fertiliser: 9%
    - straw / fodder fermentation: 6%.

FOR A FEW EXAMPLES…

Design flaw

ARIA 30809 - In a poultry farm, a wheat hopper collapsed, fatally injuring the farmer working in the vicinity. The two front feet of the storage bin got stuck in the concrete floor, causing the device to fall.

Operational anomaly

ARIA 8816 - A mix produced when cleaning the pig feeders accidentally overflowed into a nearby stream, causing nauseating odours and a serious organic pollution spill destroying the natural environment over several hundreds of metres.

Maintenance deficiency

ARIA 34110 - A fire broke out in a poultry farm. The farm building was destroyed and the 4,400 chickens it housed all suffocated to death. Property damage was estimated at €70,000, with operating losses reaching €10,000.
An electrical defect caused the fire. The farmer had not performed any regulatory inspections on the site's electrical equipment for 8 years.

External cause

ARIA 7663 - Lightning struck a hangar with a floor area of 1,100 m². The building was destroyed in less than 2 minutes and 8,400 turkeys were burnt alive. The business loss was estimated at 130,000 francs in 1995 (10 tonnes of meat) and property damage in the neighbourhood of 700,000.

Equipment malfunction

ARIA 33069 - Approx. 1,000 turkeys died when a poultry farm building burnt. An ignited leak reached an LPG tank and the fire spread to the adjoining 500-m² building. Fire-fighters set up a 1-km long water supply line and were able to extinguish the blaze in 20 minutes.

Human error

ARIA 34404 - On a beef cattle farm, a fire destroyed a 300-m² building housing 50 tonnes of straw and fodder as well as some farming equipment. The accident was caused by a farm hand, who turned on a halogen light near the straw and fodder stockpile.

Organizational breakdown

ARIA 36750 - On a pig farm, sparks were sent flying during grinding work performed above a manure pit, igniting gases emanating from the collection tank. The two labourers doing the work were severely burnt and had to be rushed to hospital.

2. FATAL ACCIDENTS

A total of 71 accidents with human casualties (accounting for 48 of the accidents) **or** serious injuries were inventoried. The most frequent causes and circumstances identified are:

- Individuals trapped in a building or storage area that has exploded or caught on fire;
- Children playing in haystacks or fodder troughs;
- Inadvertently falling into a manure pit;
- Suffocation after falling into a grain or feed silo;
- Being struck by a hay bale, or the collapse of a building or equipment on individuals, in some cases subsequent to a fire;
- Asphyxiation by fermentation gases or carbon monoxide, generated in particular from incomplete gas combustion of a building's heating system;
- Death while operating farm machinery;
- Electrocution;
- Intoxication as a consequence of a massive spill of anhydrous ammoniac, during agricultural use.

Carbon monoxide intoxication

ARIA 14882 - The owner of an industrial hen house found his wife unconscious inside the farm building, which was heated with propane gas by 24 radiators fitted with filters. Nonetheless, these filters were clogged to a point of impeding the combustion reaction due to rapidly-accumulating dust, despite daily cleaning. Also, the building's ventilation louvers only opened automatically 1 minute per hour. The site's farmers had been suffering from headaches and muscle fatigue for quite some time.

Included among the victims of these accidents are farmers, on-duty fire-fighters, and many children, family and friends of the farmer, who were onsite without being aware of these risks.

First step: Notify rescue teams

Several events reveal situations where in trying to help a colleague or loved one in danger, would-be rescuers took risks and were either seriously hurt or even killed without being able to save the initial victim.

Digesters and manure pits: Beware of hydrogen sulphide

Fermentation processes are capable of generating hydrogen sulphide, which is a highly toxic gas that remains odourless even at fatal concentrations.

Ignition of gas emanating from a manure pit

ARIA 36750 - On a pig farm, sparks were generated from grinding work performed above a manure pit, igniting around noon the gases emanating from the pit. Responders evacuated by helicopter an employee with burns over 80% of his body and drove another employee by ambulance to hospital to treat the 40% of burns on the face and hands.

Gas explosion on a poultry farm

ARIA 14151 - An explosion and fire occurred at a poultry farm that was raising 17,000 animals. Both farmers in charge of the operation were severely burned but managed to return to their home to sound the alarm. The more seriously burned victim wound up dying from his injuries. A 50-m² building and the 600 ducklings it housed were destroyed. A propane leak around the feed line relief valve on a radiator would have caused the accident. Gas would have accumulated at floor level and the door opening would have created turbulence sufficient to form an explosive mix where the incandescent radiator was located.

FEEDBACK GATHERED ON FATAL ACCIDENTS

- Identify existing risks for all those present inside the facilities.
- Secure all high-risk installations: fence built around the manure pit, barriers erected around hazardous equipment, protection systems and guidelines to ensure the safety of users working in the vicinity of hazardous machinery.
- Notify all person present on the farm of the risks incurred and corresponding precautions to be taken. Post signs or notices indicating such risks and precautions adjacent to the farm equipment.
- Ensure that children living in the vicinity of the farm are not playing inside or near the installations. Close off access to all buildings with door locks to prevent children from entering.
- Understand and acknowledge the risk of asphyxiation due to fermentation gases or incomplete combustion. Wear a self-contained breathing apparatus when penetrating zones where hazardous gases are capable of accumulating (enclosed manure pit, bottom of feed storage containers, etc.).
- Guarantee the integrity of all farm buildings and other structures as well as the stability of storage areas containing hay bales or fodder piles.
- When a building is heated, plan on minimum ventilation once heat is introduced, and even more so should the building be airtight.
- Do not overlook any of the telltale signs indicating poor air quality.
- In the event of fire, do not attempt to intervene on your own under hazardous conditions to rescue equipment.
- Refrain from penetrating into a confined zone in seeking to rescue an unconscious person, but instead immediately call emergency services.

Note: Fire prevention will be discussed in the following section.

3. FIRES AND EXPLOSIONS

3A - GENERAL REMARKS

Whether the farming activity is devoted to beef cattle, pigs or poultry, fires occur frequently and often quickly spread, inflicting heavy property damage. The events recorded in the ARIA database have been analysed to identify the major factors herein:

- **Presence of large amounts of combustible material:** raising cattle / animals requires straw and fodder either in storage or split into large quantities across the various farm buildings. Moreover, wood-frame building construction is especially vulnerable to fire.
- **Potential ignition sources:**
  - Loss of attentiveness can be noticed when performing a number of farming and maintenance operations, seemingly commonplace or non-hazardous and often unaccompanied by instructions or special prevention measures, e.g. use of motors, welding, metal cutting, waste burning, vehicle parking.
  - Electrical installations are often used under conditions featuring humidity and dust collection; these installations are capable of leading to malfunctions should they not be adapted to such conditions.

    Installations not adapted to ambient conditions, whether noncompliant or inappropriately modified, along with inadequate maintenance, flawed or skipped periodic inspections, failure to follow through on required repairs/modifications issued in inspection reports, are just some of the sources of electrical accidents.
  - Many other ignition sources have been observed among the recorded events (see summary table on the next page), including: fodder fermentation, children playing adjacent to installations and malicious intent.
- **Delayed fire detection:** Buildings in rural zones are often isolated and the farmers or their hired hands do not remain inside farm buildings all day long. Since fire detection systems with alarm relays are only rarely activated, fires are not often detected at the time of outbreak, in which case responders arrive once the blaze is already roaring and are only able to protect neighbouring installations and buildings. Other cases point to improperly functioning fire detection and alarm systems.

Electrical installations

For classified facilities being monitored through ICPE (classified installations) regulations without any hired staff, electrical installations need to be inspected every 5 years by a "certified" technician (lowered to 3 years for firms upon authorization).

The criteria characterizing this certification are not listed in the current regulations.

Proximity

In some regions, farm buildings are located in the middle of rural villages and constitute a threat, for fire hazard reasons, to neighbouring residents and structures.

Should an accident occur, it becomes much harder to rally the confidence of locals when plans turn to constructing a new farm building on the same site.

The explosions recorded in the database that were not responsible for sparking fires stemmed from gas bottles (butane, acetylene, etc.) or nearby fuel oil tanks that ignited. Such bottles and tanks are often placed inside storage buildings, close to straw or fodder stockpiles, which makes them particularly vulnerable in the event of fire. Several explosions have been traced to gas emanating from manure pits or fermentation.

In addition, wind gusts into open or derelict buildings may greatly accelerate fire damage.

FEEDBACK GATHERED ON FIRES AND EXPLOSIONS

- ✓ Identify both the combustibles and ignition sources potentially present on the farm, then distance one from the other or implement preventive measures, i.e.:

Ignition sources of common fires / explosions	Combustibles commonly involved in fires or explosions
Vehicles, farm machinery, forklifts, electric generating sets, other types of motors Electrical installations and equipment (devices used for production, ventilation, fixed or mobile lighting, water heating, fencing) Sparking on an electrical device with an automatic starter (e.g. water heater) Tools capable of generating hotspots: welding, grinding, etc. Fermentation of straw, fodder, droppings, etc. Lightning Cigarettes, firecrackers (children's games) Deliberate burning of garden debris / plant residue Exothermic reaction of chemical products	Straw Fodder Wood, cut plants Animal feed Combustible dust Household fuel oil and LPG tanks Gas bottles Tyres (used on forage silos) Plastic, cardboard, paper or wood packaging materials Greasy rags, oil and other inflammable items strewn on the ground

- ✓ Perform all operations capable of generating sparks or hotspots using tools in good working order within an unencumbered, ventilated space far from the storage of inflammable and combustible materials. Make a fire extinguisher readily accessible to all work areas.
- ✓ Fit out a room or isolate a space for the designated purpose of receiving oil and grease cans, gas bottles, fuel oil and LPG tanks, etc., thereby distancing the combustibles to avoid the spread of an eventual fire.
- ✓ Physically separate (placement in a different building, use of partition walls, etc.) those zones for storing farm machinery from other zones for storing combustibles, in order to prevent the former from igniting the latter and to protect the equipment should a fire start in the storage area.
- ✓ Regularly clean zones where combustibles can accumulate or start flowing.
- ✓ Arrange the buildings that house animals so as to easily remove the animals should a fire occur (at least 2 means of egress to the outside, in addition to the tractor door).
- ✓ Store the fodder, grain and other perishables to limit the risk of fermentation, for placement during dry weather periods in a ventilated and dry locale, with regular temperature verifications inside fresh fodder storage bins.
- ✓ Ensure that all electrical installations have been adapted to building specifications; modifications to such installations require certified technician authorisation and regular inspections. All specified repairs / changes must be performed as quickly as possible after the electrical inspections.
- ✓ Install a fire detection system that contains an alarm relay (visual or auditory signal, phone message) and be sure to test the system on a regular basis.
- ✓ Deploy fire extinguishers applicable to the kind of fire capable of occurring; be familiar with extinguisher use instructions (operations, specific features, etc.); order regular inspections; store devices in places where they will be easy and quick to access if need be.
- ✓ Request training for coping with fire and explosion risks and learning initial emergency response techniques.
- ✓ Post a list of emergency numbers in an easily visible spot and record these numbers on the mobile phone directory.

3B - FIRES AND EXPLOSIONS IN POULTRY, PIG AND VEAL FARMS

The chief characteristic of raising poultry, pigs and calves is the presence of machines and automated mechanisms that manage the various flows and utility services required for farming (feeding, air circulation, effluent disposal, lighting, etc.). Each of these components generates an electrical risk, which only gets exacerbated given that the atmosphere of farm buildings is often quite dusty.

Another unique feature relates to the presence of heating systems, for the purpose of heating buildings prior to housing animals and during the animal growth phase:

- Electric radiators or a natural gas-powered (propane) system
- Hot air generators/gas-powered (propane) unit heaters

Dual benefit

The good working order of a building's heating system serves to:

→ lower accident occurrence probabilities

→ save energy

Given their operating mode and feeding sources, these systems generate both fire and explosion risks:

Electrical heating systems	Gas heating systems
A heating device falling onto the building's straw floor (knocked over by an animal or caused by broken fastenings)	
Electrical defects	Malfunctions or gas leaks (e.g. resulting from dust clogging)
	Gas leak upstream of the heating system (piping, tanks)

Propane leaks inside closed buildings with little ventilation may lead to especially catastrophic consequences. The farmer or a farm employee might cause an explosion by opening the building door, an action that would stir the escaped gas accumulated on the floor, allowing an explosive mix to form at the level of the incandescent radiator (ARIA refs. 14151, 32891-Appendix C). Another potential ignition source: sparks created on an electrical device with an automatic starter.

The LPG tanks that supply heating systems are sometimes inefficiently utilised, or installed under conditions not conducive to proper safety, or inadequately modified (e.g. inaccessible emergency shutoff button). The slightest gas leak can have a dramatic impact.

Sources of clogging

Some atypical activities are sources of dust collection or heating system clogging; it is necessary therefore to plan out a cleaning schedule.

ARIA 33144 - The destruction of a hornets' nest might have led to clogging a heating device, which in turn caused the building to catch on fire.

175 animals asphyxiated

ARIA 32207 - 175 calves died of suffocation when two 800-m² ultra-modern farm buildings burnt. The ventilation system that malfunctioned subsequent to a short circuit was the cause of this accident. The presence of a propane tank nearby complicated fire-fighter response efforts.

Photovoltaic cells

Farm building roofs with large surface areas are being increasingly hired to deploy solar panels.

→ The fire risk related to this type of installation should be analysed and targeted for protection and prevention measures.

FEEDBACK GATHERED ON FIRES AND EXPLOSIONS

- Ensure that heating systems are solidly fastened, used regularly and appropriately maintained; request inspections on a regular basis by a "certified" technician.

- Verify that the thermal radiation is not of a level to set fire to straw lying on the floor or stored nearby.

- Ensure that the gas supply equipment for heating systems (tanks, piping) is being used and maintained properly; order regular inspections by a "certified" technician. Verify that this equipment is solidly fastened and far enough away from zones where animals can reach it. Are tank accessories (valves, etc.) protected from inclement weather exposure and adequately secured? Are emergency shutoff buttons accessible and in good working order?

- For major indoor installations, it might be prudent to conduct a study of the available resources that would need to be implemented in the event of fire (fire hose station, sprinkler system), ensuring compatibility with ambient conditions (dust collection, etc.).

- Limit dust accumulation as much as possible (adjusting the ventilation system, regular cleaning, or on a systematic basis upon completing an operation that produces airborne dust, etc.).

3C - DIFFICULTIES EXPERIENCED BY EMERGENCY TEAMS

When responding to fire emergencies on farms, fire-fighters have often encountered difficulties, namely:

- water supply problems due to isolated building locations, necessitating a tank-trucks supply chain: nearest hydrants hundreds of metres away or with insufficient water pressure, lack of a static water supply in the vicinity;
- rapid fire spread due to the presence of combustibles (fodder, straw, wood, etc.);
- onsite access difficulties due to poor signage of the path to follow;
- constrained access to the burning zone as a result of the structural design and building layout;
- need to protect the farmer's home, which is often positioned next to the farm buildings;
- leak and explosion risks:
  - gas cylinders (LPG, acetylene, etc.), household fuel oil or LPG (propane) tanks, gas pipes for heating systems, which often run close to buildings and in some cases even inside them;
  - ammonium nitrate supplies.
- collapse of burning structures, placing fire-fighters at risk of injury and blocking access to the other fire zones;
- release of toxic fumes from onsite chemical products, including phytosanitary products, should they be ignited;
- lack of lighting in isolated zones;
- presence of a high-voltage electrical line either running above or adjacent to the farm.

Three fire-fighters perish

ARIA 3034 - In 2005, at Metz-le-Comte (eastern France), three volunteer fire-fighters were killed when the wall of a burning farm building housing hundreds of straw and hay bales collapsed.

Avoiding a secondary accident

Fire extinction water sprayed onto a site leaches all substances into the soil (fuel oil drained to the ground, fertiliser, other chemical products, liquid manure, etc.) and is capable, if not contained, of polluting the natural environment.

It is therefore critical to install, once the fire breaks out, an earthen retention or any other means to confine this water, with even greater urgency should it have access to a watercourse.

Hazardous waste management

Besides animal cadavers, asbestos-laden wastes must be processed via a specific treatment channel for health reasons. The debris from roofs made of asbestos cement (still commonplace) bursting due to the heat released by fire often gets mixed with other materials, thus complicating the sorting step.

Fuel oil tank explosion

ARIA 5717 - A fire destroyed a 600-m² metal frame farm building made of concrete blocks and protected by roofing panels; the building contained 100 tonnes of fodder, a 4,000-litre storage bin of oil, 8 aboveground fuel oil tanks offering a total capacity of 11,000 litres, plus a 10,000-litre underground fuel oil tank. More than 30 minutes after ignition, while the entire building complex was in flames, the aboveground tanks exploded one after the other. The powerful blast created had no impact on either the already levelled building nor on the emergency crew's task. The underground tank sustained no damage, and no victims were reported.

Depleted backup water supply

ARIA 35143 - A fire broke out around 5 am in a 1,500-m² pig house containing a herd of 1,000 sows and 200 tonnes of straw. Fire-fighters scrambled to prevent the fire from spreading to the site's remaining buildings (which account for another 2,500 m²) and protected the gas tank, refrigeration units and cold storage rooms located in the transformation-packaging shop. Since the farm's backup water supply was quickly depleted, tank-lorries extracted and carried water from 3 nearby points up to the arrival from the city of Châteaudun of a large tank to supply fire-fighters, who were pouring water at a rate of 3,000 litres a minute through 6 nozzles.

FEEDBACK GATHERED ON EMERGENCY RESPONSE DIFFICULTIES

- Identify the set of difficulties that rescue teams are likely to encounter in the event of fire and modify / adapt installations to maximise the effectiveness of mitigation measures.

- Inspect the farm during a visit with fire-fighters (often volunteers in rural areas) who would be called in response to an accident, to ensure they are aware of how to quickly access the site and familiar with the building configuration, installations used, products stored and potential sources of fire water supply. Local fire-fighters can also take this occasion to propose solutions to limit the probability of fire occurrence and facilitate an eventual response.

- In the absence of a nearby fire hydrant, install a sufficiently large-capacity extinction water backup supply.

- Keep up to date at all times with the types of products stored, their quantity and storage location (e.g. maintain and regularly update a log) in order to provide responders, under emergency conditions, with useful information to aid their efforts and assess the eventual risk of "domino effects".

- Separate, to the greatest extent possible, gas and fuel oil tanks from the buildings.

- Distance the gas cylinders and ammonium nitrate storage containers from combustibles, which must be stored to allow for speed of removal should a fire break out (i.e. no belowground storage, on an upper floor, within an "enclosed" room, or in back of the straw storage area). It is necessary to comply with the best practices indicated in existing professional guides (covering, for example, fertiliser storage).

4. ACCIDENTAL POLLUTION

A significant proportion of events recorded in the database entail the discharge of hazardous substances and environmental pollution. Various types of polluting materials and products are capable of being released accidentally into soils and streams, potentially affecting natural aquatic life and fish farming activities:

Products / substances capable of harming the natural environment	Types of storage / containers
Fertilisers	Stationary or mobile tanks, containers or bags
Phytosanitary products	
Detergents, disinfectants, biocides	
Medicine for animals	
Household fuel oil	Tanks (often aboveground)
Manure / liquid manure	Manure pits, temporary pits, collection pipes
Silage slurry	
Milk	Milk tanks
Wastewater, cleaning water	
Feed for animals	Bags, silos, feed bins

Several anomalies are the cause of the accidental pollution identified in the database events studied herein:

Site design problems:

- Lack of a liquid effluent recovery system;
- Absence of retention basins underneath storage tanks and mobile containers, or alternatively retention basins with compromised seals;
- A storage tank poorly secured and inadequately protected against aggressions (overturned by an animal or exposed to vehicle shocks), or even displaced during a flood;
- Insufficient manure pit capacity, causing overflows in the case of excessive filling or heavy rains;
- Designated storage at floor level or else unprotected from inclement weather: rainfall leaches into the soil, bringing with it exposed products and other substances (silage slurry, cereal waste treated with phytosanitary products, manure, etc.);
- Design flaw for a manure pit, resulting in accelerated pit deterioration (mixer installed directly on the geomembrane).

Physical defects and lack of oversight and maintenance of storage equipment:

- Leaking tanks containing fuel oil or fertiliser: corroded tank shell, faulty valve seal, break of a support fastening;
- Broken hoses and pipes connected to fuel oil tanks and liquid fertiliser tanks, leaking manure casks: wear, loosening of the clamping collar;
- Rupture of the manure pit wall causing a major spill: structural ageing, subsidence of a neighbouring building;
- Leaking manure pit conduits: localised leak, sudden failure;
- Defective pumps hooked up to manure pits or household fuel oil tanks, causing spills;
- Overflow of a fertiliser or fuel oil tank during a move: broken coupling, poor handling, etc.

Operational breakdowns and poor practices:

- Absence of monitoring during transfer of fuel oil, fertiliser, phytosanitary products or manure, leading to product spillage;
- Plug / valve left open or poorly closed on a tank (fuel oil, milk, fertiliser, phytosanitary products);
- Poor product handling;
- Discharge of washing water (used on building floors, chemical product containers, milk tanks, manure or other products) directly into the environment due to negligence or lack of awareness of the product's danger to the environment;
- Manure pit overflow due to heavy rainfall or a major water leak in the vicinity;
- Open-air burning of chemical products (phytosanitary, etc.), or dirty packaging capable of contaminating neighbouring soils and plant life by smoke and ash.

Farmers may be criminally prosecuted for causing pollution

France's Rural Code, Environmental Code and Law on Water Quality and Aquatic Life (Law No. 2006-1772, adopted December 31, 2006) qualify as misdemeanours any actions leading to the spilling of solid, liquid, toxic or inflammable substances capable of polluting water; the principle of preventive and remedial measures is always applicable. In case of noncompliance with this principle, the farmer may be charged criminally for a water pollution misdemeanour, even if the act was not intentional.

Rupture discovered upon thawing

ARIA 31898 - During an inspection, a sizeable quantity of effluent was observed alongside a building, adjacent to and underneath a pipe transporting manure from the building to the temporary pit. According to the farmer, the spreading of manure resulted from a pipe break during the winter, with consequences only being recognizable at the time of thawing.

20 km of polluted river, 16 tonnes of dead fish and a €125,000 fine

ARIA 19835 - The breaking of a door to a manure pit that serves a hen house led to the overflow of approx. 300 m³ of chicken droppings into the Magoar River and then into the Trieux River over a 20-km stretch. Three fish farms were adversely affected (16 tonnes of dead fish). The poultry farmer was fined €75,000 and charged another €50,000 in damages and interest.

Use of liquefied ammonia

Liquefied anhydrous ammonia, which is used on occasion to fertilise soils, is indeed toxic, corrosive and hazardous for the environment.

It is thus essential for farmers using this substance to be trained in all techniques related to storage, use and transport and moreover for the equipment to be in perfect condition.

Specifications on the construction and use of agricultural ammonia transport equipment as well as on the corresponding hoses are listed in the May 29, 2009 decree relative to the land transport of dangerous goods.

ARIA 36191: Coupled to a tractor, a tank containing 2 tonnes of agricultural ammonia overturned alongside a road running parallel to a cornfield. After a tapping valve broke, the tank emptied its contents and a 800-m³ cloud of toxic and corrosive gas formed. With no wind to dissipate it, the cloud stagnated for 30 minutes; farm vegetation was burned over an 8-ha area (300-m radius). The local gendarmerie and fire station established a safety perimeter over a 500-m radius. On behalf of the farming cooperative and assigned to dissipate the cloud, a motorist following the tractor became intoxicated and had to be hospitalised. The manager of a nearby campground and the sole camper there were evacuated from the premises.

Stream polluted subsequent to the overflow of cleaning water in a ditch

ARIA 33225 - The Lausset stream was polluted and tens of fish died. A farmer poured out cleaning water from a liquid fertiliser tank into a ditch, which then trickled into the stream.

Organised collection of hazardous farm waste

Waste collection activities dedicated to the farming sector (expired phytosanitary products, soiled packaging, etc.) are taking shape locally; these activities reroute the waste collected into appropriate treatment channels.

FEEDBACK GATHERED ON ACCIDENTAL POLLUTION

- Learn about the properties of all products present on the farm along with potential risks to the environment, in case of a massive or even less serious spill. Notify all individuals working on the farm and post instructions in order to avoid discharge into the natural environment due to a lack of knowledge or to negligence. Never discard anything directly into the environment. Always route hazardous waste to the appropriate treatment channel.

- Place stationary reservoirs and small mobile storage containers (e.g. casks) on a sealed retention basin, whose capacity is at least equal to that of the reservoir and containers combined.

- Waterproof the wall surfaces and bases of farm buildings and install a water recovery system (cleaning water, rainwater, etc.), channelling water to a storage or treatment system.

- Design effluent storage facilities and corresponding pipes so as to ensure their structural integrity over time; verify that facilities are sized large enough with respect to the loads they'll need to accommodate (adding a built-in safety margin).

- Capture rainwater from roofs to avoid mixing with farm effluent and for discharge within a designated area. This water can then be stored for subsequent use, or discharged into the natural environment or into a specific network.

- If a stream, pond, wetland or natural zone lies downstream of the farm, set up a physical protection at the level of the buildings and storage areas containing the pollutant (retention weirs placed for example at building openings).

- Solidly fasten to the ground all tanks that are not designed to be moved.

- Store chemical products, in avoiding any direct contact with the ground, in a place where:
  - products are not vulnerable to tipping over, e.g. by either a vehicle or an animal,
  - they are protected from rain in order to prevent being soaked and carried away.

- Regularly inspect the integrity of manure pits and other effluent storage devices, fuel oil or fertiliser tanks, conduits and pipes, etc. as well as that of adjacent structures; adopt appropriate measures should an anomaly be detected: stop using the pit or tank; or install a physical barrier to contain any eventual flow for the time required to perform the necessary repairs. Older storage tanks would need to be inspected and ultimately changed if the risk of a leak is found to be high (e.g. case of corrosion).

- Handle products and clean small-capacity tanks in a zone where any accidental effluent and flows would be captured.

- Monitor all aspects of product transfer operations and frequently verify that all valves and plugs are adequately closed; markings may be indicated on these devices in order to more easily identify whether they are closed correctly.

- Prior to moving any storage device, check that it is well secured onto the transport equipment and in good condition, in addition to ensuring that the itinerary chosen minimises the risk of being overturned.

- Monitor the manure pit filling level, especially in the event of heavy rains should it not be covered, for the purpose of avoiding spillage.

5. OTHER ACCIDENTS

400 pigs asphyxiated

ARIA 32639 - 400 pigs bred for slaughter died of suffocation at a farm after electrical supply was cut off to fans during the night. The alarm system was inefficient due to a transmitter malfunction. The transmitter would later be changed and a double safety measure installed.

Alarms

Alarm systems must be tested on a regular basis. Some of the recorded accidents actually indicated that an alarm had been installed but failed to trigger when the accident occurred.

Electric arc

ARIA 24451 - A lorry delivering cattle feed caused an electric arc on a 20,000 volt (high-voltage) line by deploying an articulated arm to fill a silo. The lorry tyres exploded without igniting a fire. The lorry driver was in a state of shock.

Chemical reaction

ARIA 31767 - Fire broke out within a 300-m² farm building. Following rainwater flow, an exothermic reaction occurred on the 20 tonnes of lime adjoining 24 tonnes of ammonium nitrate, as well as on a fodder storage area, the milking room and quarters for 80 head of beef cattle without any egress. The responders removed the ammonium nitrate and stored it separately in a protected hangar; moreover, they created a sand layer around the lime stockpile and tried to snuff out the open bags.

Wall collapse

ARIA 34980 - On a beef cattle farm, a concrete wall of an enclosed dung heap ruptured at night, causing the building's roof to collapse. The farmers dug a pit to recover the effluent after scraping. Pit contents were pumped and the recovered manure could be stored in another well-adapted installation. Nonetheless, a proportion of the effluent flowed into the neighbouring brook. One month later, the pit was completely drained; output from the dung heap could be controlled and the impact on the brook was mitigated.

Electricity outage

ARIA 29400 - 435 pigs weighing 40 kg suffocated to death subsequent to the shutdown of feed building fans. Upon inspection of the electrical installation, the outage caused by the differential switch would have been due to two 1,500-W finned radiators, which had not been adequately insulated.

Risk of silo collapse

ARIA 33639 - A metal corn silo 14 m high and 5.60 m in diameter was in danger of collapsing onto a farm building housing some 100 head of beef cattle. Emergency crews set up a safety perimeter around the border of the container. Upon the advice of 2 steel construction specialists, fire-fighters unfastened this silo from another adjacent storage chamber at the level of an I-beam, over its upper part, and then installed a towing chain in order to prevent the structure from falling. On the next day, a subcontractor drained the silo entirely.

Fire

ARIA 17772 - A fire destroyed 170 m² of a farm hangar used to house animals without stalls for beef cattle, in addition to storing fodder and farm machinery. Two cows were injured; some agricultural equipment was damaged; and 70 tonnes of fodder were lost. The roof had to be removed by a specialised contractor (due to the presence of asbestos). A portion of the hangar was reserved for the mechanics workshop, yet no partition wall had ever been installed to separate the various activities.

Flameless combustion

ARIA 11032 - In an industrial hen house, the flameless combustion of a bed of wet ground straw produced very dense fumes that suffocated nearly 11,000 chicks. Once cleaned, the building was shown to have sustained no damage and was fit for reuse.

Non-verified installations

ARIA 11032 - A fire broke out around 2 in the morning at a poultry farm listed as a hazardous facility. The farmer tried to put out the blaze with extinguishers before fire-fighters got the fire under control. The building was destroyed and the 4,400 chickens it housed all suffocated to death. Property damage was assessed €70,000, while operating losses amounted to €10,000.

An electrical malfunction was the cause of this fire. The farmer had not ordered a regulatory inspection of electrical installations for 8 years. He is planning on constructing another building on the site.

PROPOSED NEXT STEPS

This analysis of a large number of accidents recorded in the ARIA base has confirmed that farming facilities, their associated equipment and the materials used all justify the need to develop a risk prevention approach for protecting both human health and the environment.

Such an approach is to be laid out around a few simply stated guidelines, with greater or lesser detail depending on the magnitude of these risks:

- ✓ Build awareness among the relevant trade organisations and the farming community regarding risk prevention.
- ✓ Inform all individuals present on farm installations of the existing risks and precautions to be taken. Avoid downplaying these risks.
- ✓ For all units and equipment, identify the hazardous or polluting materials present, as well as the operations performed that are capable of generating a risk to human health, the environment, property or the production tool itself.
- ✓ Arrange and secure the installation and moreover establish working instructions in order to minimise the probability of accidents and reduce potential consequences. Verify their effective application as a follow-up step.
- ✓ Regularly inspect, maintain and clean the installations.
- ✓ To the greatest extent possible, install alarm devices in the event of anomaly detection, and test such devices on a regular basis.
- ✓ Fires are not a fatality: some can be prevented by implementing measures that often prove quite simple.
- ✓ Anticipate the difficulties that emergency services might encounter should a fire break out or hazardous materials be discharged (accessibility, water supply location, hazardous materials separated from the combustibles zone or else easily moved, physical barriers to prevent flows, animal removal, etc.).
- ✓ Train all those involved in risk prevention (relative to fires, pollution, explosions, etc.) and demonstrate the kind of behaviour to adopt in the event of an accident.
- ✓ Share feedback from situations regarding accidents or near-accidents with other farmers.