Major fires

Included in the category of major fires would be all blazes that generate damage beyond the specific unit or machine where the initial ignition occurred. This fact sheet will expose the human potential, social, environmental and economic consequences tied to these events.
Beyond the exact causes (malicious act, electrical malfunction, equipment defect, hot spot works, etc.), it is the combination of aggravating factors that actually assigns the qualifier "major" to a particular fire outbreak. A number of these aggravating factors are described in the present fact sheet.

The proportion of major fires occurring at classified facilities amounts to roughly 35% of all fires listed in the ARIA base.

Trend in accidents categorised as fire / major fire since 2008	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***
Number of fires recorded in the ARIA base	*675*	*604*	*605*	*625*	*561*	*553*
Number of major fires (with entire building exposed to damage) recorded in the ARIA base	*190 (28%)*	*262 (43%)*	*227 (37%)*	*242 (39%)*	*205 (36%)*	*165 (30%)*

1. A cost for the company

1.1. Economic consequences

The average cost of damages ascribed to major fires in France equals approx. **€780,000** per accident, from a sample size of 338 accidents where this parameter has been recorded.
More than **26%** of these accidents resulted in economic consequences **greater than one million euros**. This cost threshold is reached by the loss of all or part of production capabilities during the fire, by destruction of the production building and machinery and by forced layoffs of the workforce.

1.2. A human and social cost for the company

The human and social consequences associated with major fires, out of a sample of 2,760 accidents compiled since 1994 and catalogued in the ARIA base, are as follows:

Human and social consequences	***Number of accidents recorded***	***%***
Loss of life	*32*	*1*
Serious injuries	*48*	*1*
Minor injuries	*508*	*18*
Forced layoffs	*756*	*27*
Population evacuated	*191*	*6*
Population confined	*41*	*1*
Safety perimeter installed	*409*	*14*

It should be noted that a number of accidents have required the evacuation or confinement of a segment of the affected population, and/or the installation of a safety perimeter outside the site boundary.

1.3. A lower cost for the natural environment

Only **4% of major fires**, from the sample of 2,760 accident records compiled since 1994 and catalogued in the ARIA base, had an **impact on local aquatic media (surface water or groundwater) or soil**. Extinction water is in large part confined on accident sites before being treated, thanks in particular to the existence of retention basins or storm drain system isolation valves.

Accidents generating an impact on the natural environment however are primarily due to the absence of appropriate fire extinction water recovery devices (shut-off valves, retentions, basins, etc.), including a loss of their sealant, inadequate design, poor maintenance or malfunction.

2. The aggravating factors associated with a "fire" type of accident

2.1. Building designs conducive to the spread of fire


Source : operator (ARR)

Several fires catalogued in the ARIA base involve buildings whose roofs, facades or installed equipments had been designed with combustible materials (e.g. combustible sandwich panels, polyurethane foam, wood structure and facade elements, and glass wool). These materials feed the fire and may complicate fire-fighter response, especially in light of the risks of structural collapse.

In addition to the choice of materials, aggravating design factors include:
- the absence of physical barriers or building compartmentalisation (e.g. fire walls) which would make it possible to contain or even halt entirely the spread of fire;
- the presence of machinery or amenities that promote fire propagation from one building to the next (conveyor system, ventilation ducts, openings in the fire doors).

ARIA 41482 - 24 December 2011 - 42 - SAINT-ETIENNE

Fire broke out around 4:35 pm in an industrial packaging company occupying 7,500 m² of floor space. The firm held in inventory 5,000 m³ of paper, cardboard and plastics, 32,000 m² in army archives storage (with 36 linear km of shelves) and a 2,500 m² mail sorting platform.

A thick plume of black smoke was visible over several kilometres. Nearly 120 fire-fighters had to be mobilised. All utility lines were closed and the entire district cordoned off. Around 1:30 am, the fire wall protecting the mail storage facility partially collapsed. First responders extinguished the last ignition sources on 28 Dec. The industrial packaging firm was completely destroyed. **The postal site was inoperable for just a short while as it had been well protected by the fire wall**. The army archive centre sustained damage.

The building had initially been equipped with sprinklers, but this installation was subsequently disassembled. After the accident, it was decided that a **30 m buffer space between the archive building and the warehouse would be introduced** during reconstruction. **Ceiling insulation** (flocking over a 5 m distance below the roof line) **was also to be reinforced. The building's facade protection turned out to be inappropriate given the exposed heat flux. The lack** of both fire protection and **compartmentalisation in one of the storage cells had in fact facilitated the spread of this fire**.

2.2. Delayed detection

The early detection of a fire influences the speed with which an effective response can be organised and deployed.

In several of the accidents catalogued in ARIA, it would appear that fire detection did not facilitate a quick response during the accident for the following reasons:
- **absence of fire detection**;
- presence of fire detection, but **lack of detectors installed at the site of the outbreak**;
- **inoperable detection device** due to:
  - deliberate decision by the facility operator to turn off the detection system, mainly for the purpose of proceeding with works or,
  - accidental detection system shutoff by, for example, lightning or **electrical outage**.

ARIA 25495 - 15 August 2003 - 38 - LE PONT-DE-CLAIX

Fire broke out in the nitrocellulose warehouse at a printing ink factory closed for annual holidays. **Given the absence of on-site personnel combined with a warehouse facility devoid of fire detection**, the alarm was sounded by neighbours. Fire-fighters responded quickly and had the blaze under control within 30 min. **The premises were completely destroyed : 3 walls had collapsed, and only the facade fitted with a metal access door was able to resist the fire.** The 4 tonnes of nitrocellulose stored in the warehouse were destroyed, as were the 6 barrels of substances previously opened and positioned in the 2 storage cells next to the warehouse. According to the factory operator, these products being consumed had been properly handled in their original plastic packaging placed in hermetically sealed barrels. Given the extreme heat recorded during the days preceding the accident and the absence of personnel for more than 5 consecutive days, evaporation of the nitrocellulose impregnation solvent caused its self-ignition. The Prefectural authorisation ordered constant monitoring of the storage zone to ensure that the solvent ratio did not dip below the normal concentration maintained at the time of acceptance.

2.3. Fire-fighting resources that are improperly designed or ill-suited to the type of risk

Several accidents listed in the ARIA base report a sudden drop in flow rate within fire extinction water networks during emergency response or, more commonly, **a depletion of water resources** available on-site to fight the blaze. As a result, the time spent by fire-fighters required to seek alternative water supplies (basins, rivers, tanker truck deliveries) winds up slowing the response.

Another aggravating factor in the event of fire pertains to the automatic extinction or smoke extraction systems connected to the general electric grid that become **inoperable upon shutting down the power supply**, whether involuntary or a deliberate step taken by the site operator or first responders.

The analysis of major fire accidents also suggests that the **fire protection and response system** implemented by the operator proves at times to be **ill-suited** to the risks inherent to site activities. Moreover, one of the measures adopted by operators following an accident involves conducting a risk analysis, with the aim of reconfiguring the site's protection and response system.

2.4. Vapour, dust or air extraction systems capable of fanning fires

The presence of an **operable extraction or ventilation system** at the time of a fire outbreak promotes spreading by acting as a conduit for ignited particles or by fanning the combustion, thus triggering the formation of flames.
This factor is definitely present in fires occurring in silos, woodworking shops, or within surface treatment facilities.

ARIA 32480 - 11 November 2006 - 21 - VILLERS-LES-POTS

Around 11 pm, at a 6,000 m² vegetable transformation and conservation plant, **fire broke out in the 200 m² room housing the ventilation and air conditioning equipment and spread into the suction ducts**. Heavy smoke was released in 2 adjacent buildings measuring 200 m² and 600 m², respectively. First responders cut off the electricity supply and **then isolated the ventilation and air circulation ducts**. They located the ignition source in the filtration room at the base of a chimney and proceeded by deploying 4 fire hoses to contain the blaze. The roof-mounted smoke removal system and sprinklers installed in the premises adjoining the plant's main boiler room were activated. **Fire-fighters perforated the ducts that had become abnormally hot**. Around 2:20 am, assisted by the Production Manager, **they located several other ignition sources, notably in the furnace extraction ducts and general exhaust chimney; they continued with their extinction efforts**. 30 min later, after surveying with a thermal imaging camera, no more hot spots were detected and responders left the premises. No victims were reported, but the site's production facilities were shut down for an indefinite period.

2.5. Vigilance in regions subject to wind disturbances

Wind is an aggravating factor regularly encountered in accident records. It stimulates the propagation of fire from one building or one facility to the next and fans flames. Wind also limits the efficiency of smoke exhaust outlets.

> **ARIA 33271 - 23 July 2007 - 26 - DONZERE**
> A violent fire broke out around 2:30 pm at a hazardous waste treatment centre. The blaze ignited in an outdoor stockpile of plastic rolls and then spread to the storage of paper-cardboard and adjacent pallets, before reaching the 5,500-m² materials sorting building. **Fanned by strong winds, the fire extended to nearby brush and destroyed 2 ha of vegetation bordering the neighbouring motorway**. On a positive note, a diesel tank in the vicinity was spared. Traffic on the motorway was slowed for a 4-hour period. No victims were reported, but the centre's 20 employees all had to be temporarily laid off.
> This fire might have been caused by malicious act, but its quick spread had been facilitated by the short distance (less than 10 m) between the various storage sites and the main building.

3. Conclusion and recommendations

For companies, the costs of damage generated by a major fire are significant enough to motivate site operators to consider implementing a set of measures to combat this risk.

Analyses of major fires expose a large number of exacerbating factors. These factors must be identified in order for the operator to adapt site operations and as input into the risk analysis of their installations.

Risk analyses are typically conducted during project design via the generation of a safety report. Let's recall however the importance of repeating this exercise each time a new event arises in the life cycle of an installation. This is the basic task that allows identifying installation vulnerabilities and hence scheduling compensatory measures.

A few sample measures to keep in mind:

- compartmentalize the site units in order to avoid the propagation of hazardous phenomena;
- install fire protection devices (walls, check valves) or decoupling systems, notably in silos whenever the installation contains conveyor belts;
- adapt the type of fire-fighting equipment to the specific risks of the given industrial activity;
- ensure availability of the site's retention capacity for the extinction water volume, and adapt this capacity to subsequent changes in activity;
- set up a fire detection system that relies on its own energy supply and is relayed to secured alarms. The facility-wide management of these alarms must be governed by separate instructions and procedures;
- verify the presence, proper design and maintenance of extinction water recovery systems (shutoff valves, retention capacities, basins, etc.);
- become familiar with the types of materials introduced and the fire resistance of all buildings, structures and equipment (tanks, ducts) making up the facility.

Besides accounting for these aggravating factors in the facility design and life cycle, it is necessary to adopt the organisational measures that enable maintaining a high level of on-site safety (guidelines, procedures, training, choice of equipment, maintenance, control systems, etc.).