Emergency preparedness and response

At major hazard industrial sites, planning and responding to emergencies is a regulatory obligation. Its objective is to provide the site operator with the tools to manage an accidental, hazardous phenomenon with internal site resources (on-site preparedness and response) or to offer backup to public first responders, who have been notified by the operator in a timely manner, should the magnitude of this phenomenon lie beyond his control and/or jump the site boundary (interface with off site responders). The preparedness and response organisation studied in this document does not address workplace accidents but rather those involving manufacturing processes.

1. On-site response organisation

A well-designed on-site response organisation anticipates the proper and exhaustive identification of any hazardous phenomena that may arise on-site. This is one of the purposes of the safety report, since the selected accident scenarios make it possible to define both the right preventive barriers to implement along with barriers to lessen the impact of the accident and reduce any proliferation by acting pre-emptively. While fire remains the most common hazardous phenomenon for the majority of French industrial sites (see Fig. 1), the on-site response organisation must still not overlook other accidental phenomena specific to the site's activity i.e. those that differ from fire in their nature, frequency and speed - and which, nonetheless, require specialised response procedures and equipments - such as toxic leaks, anoxic atmospheres and environmental pollution.

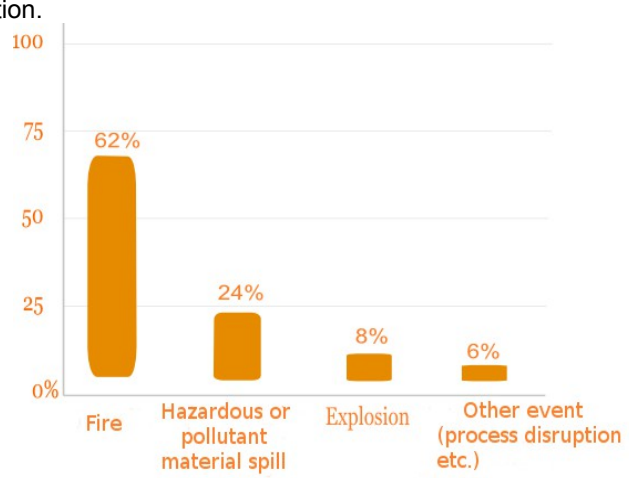


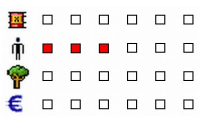
Figure 1: Typology of phenomena of over 26 727 French industrial accidents in the ARIA database, 1992-2012

The site's size and financial resources are determining factors for on-site response organisations: a small company often limits its efforts to training staff to the use of fire extinguishers, whereas an industrial platform combining several Seveso-rated facilities tends to be equipped with its own team of professional fire-fighters, in addition to teams of first responders and even second responders selected from among site personnel who have undergone the requisite training and drills.

An efficient on-site response organisation can be characterised according to the 4 following criteria:

1.1 Availability of operational and adapted technical response resources:

These resources can be broken down into several families: stationary or mobile, manually activated or automatic (Fig. 2). The advantage of a stationary means of extinction lies in its speed of deployment and proximity to the source of the hazardous phenomenon, thus making it recommended - or even mandatory - according to professional standards, regulations and facility insurers despite significant installation costs and maintenance constraints. Moreover, the widespread use of hazardous phenomena sensors now enables automatic activation, which saves time and minimises human presence outside of the site's normal business hours. Paradoxically, their operating speed and/or problems with settings/malfunctions can sometimes cause an accident or a secondary accident, as illustrated in the following summary:



ARIA 26999 - 27 April 2004 - 27 - GAILLON
In a coffin factory, fire broke out around 11 am in a 1500 m² varnishing workshop housing 500 kg of polyurethane and 20 litre cans of solvents. **Subsequent to activation of the automatic foam extinguisher and closure of the fire doors, the 20 employees present on-site inhaled foam; 5 of them were seriously**

affected and had to be hospitalised, while the other 15 were examined at the scene by first responders.

On the other hand, mobile fire extinction resources offer lower costs yet add the constraint of requiring set-up by on-site personnel trained to their use. In the event of an accident outside of normal business hours or in the presence of untrained staff, their proper deployment becomes uncertain and their efficiency may potentially be compromised.

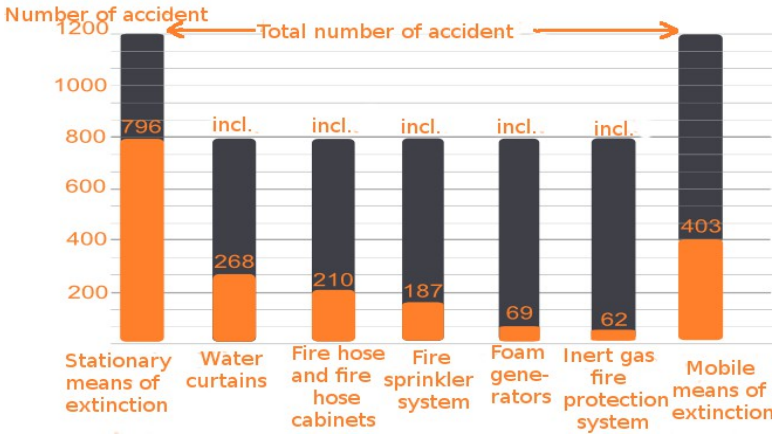


Figure 2: Distribution of extinction resources by type (sample of 1 200 accidents in the ARIA database)

It is important to remind that since extinction resources are in fact technical devices, they may fail due to internal causes (poor maintenance, improper settings, inadequate design) or external causes (domino effects, natural phenomena, utility outages), as shown in the following accident:

> **ARIA 41638 - 07 February 2012 - 13 - TARASCON**
> In a lower-tier Seveso-rated paper mill, fire broke out around 5:30 am in an outdoor storage zone containing 10,000 tonnes of wood bark. **Since the site's fire response network was inoperable, emergency crews installed 2 pumps on the RHONE 700 m away. Nonetheless, due to low temperatures, the water froze in the outflow pipes.** Fire-fighters were thus forced to let the entire inventory burn. During their intervention, many on-site machines also proved to be inoperable, experiencing mainly hydraulic defects like: frozen sensors, impossibility to open and close valves, and burst pipes. Major physiological constraints also interfered with the response effort: frostbite led a number of first responders to seek medical attention.

1.2 Allocation of well-trained human resources:

On an industrial site, the ability to efficiently control a hazardous phenomenon often presumes the action of on-site employees, given their proximity to the unfolding accident. The severity and magnitude of the accident depend on the speed and efficiency of the response by staff. Their training and the refresher courses offered are thus critical components when organising emergency services. This instruction must cover two aspects:

- knowledge and a strong understanding of the hazardous phenomena occuring within the installations, so as to provide the response personnel with a realistic perception of the hazards thus avoiding a behavioural response of panic or risk-taking;

- response techniques. Training modules will be more extensive and frequent as the resources that enable personnel to control hazards become more specialised: spraying a fire extinguisher is quite different from operating a foam nozzle while wearing a Self-Breathing Apparatus.

1.3 Establishment of response procedures:

Like any organisational effort, setting up on-site response organisations assumes prior consideration has been given to coordinating available technical and human resources through defining roles and staging "typical" response scenarios adapted to the primary hazards identified. This approach is formalised as a mandatory emergency plan or, for Seveso-rated sites and specific designated high-risk facilities, a mandatory internal emergency plan to be revised every 3 years. The procedures associated with this plan must be consistent with the accident scenarios selected in the safety report or hazard assessment. However, when the current situation no longer corresponds to these scenarios, the procedures must be

flexible enough to assist the response team leader in making the right decision without forcing the implementation of techniques that would not be appropriate. The following accident indicates that the lack of formalised procedures as part of the emergency plan may be an exacerbating factor:

ARIA 45008 - 03 March 2014 - 71 - BRANGES

At around 5:15 am in a poultry slaughterhouse, an ammonia leak was observed on a solenoid valve placed on refrigeration installations. 183 employees had to be evacuated, 30 of whom received treatment by first responders and 6 were transferred to hospital. The following exacerbating factors were identified: **1. an inefficient evacuation (no alarm sounded, no guidelines issued by plant managers); and 2. an unsuitable operating protocol for responding in the event of a NH_3 liquid phase leak** (difficult access to shut-off valves trapped in the ice, inappropriate protective equipment). **The plant operator requested revising both the response and evacuation procedures,** validating them through drills and acquiring NH_3 measurement devices.

1.4 Scheduling and practising regular drills:

The incidents and accidents requiring the mobilisation of on-site response organisations (fortunately) prove to be quite infrequent at any given industrial site. For this reason, regular response team drills are necessary to ensure the on-site response organisation remains fully efficiency in the long run. The diversity of scenarios, and sometimes the diversity in resources deployed, justifies the regular scheduling of drills. Such exercises also offer the opportunity to determine what needs to be improved or revised, in regards of both equipment and procedures. It remains necessary however to clearly identify the realistic limitations assigned to these drills, so as to avoid needlessly subjecting personnel to risk or causing an accident.

ARIA 11160 - 19 October 1996 - MIESBACH - Germany

Inside the warehouse of a waste recycling company, during a fire drill, **a professional fire-fighter lit a smoke bomb to simulate a fire. The firework ignited, and the ensuing fire spread to stored materials, setting the entire building ablaze.**

2. The interface with off-site response organisations

The on-site response organisation must also plan "operational" early warning systems to alert off-site response organisations that might be called to assist in emergency operations: public first responders, the mayor of the municipality, a designated service provider (specialised response equipment), and field support units (experts and instruments). This "operational" early warning system shall also alert services that may be called to help reduce accident severity, whether on-site (utility suppliers) or beyond (neighbouring plants, public facility managers), and to those governmental agencies that shall be mandatory informed by law (eg. environmental control agencies).

Should the resources available offer the possibility, these various systems must also include informing the entities that might be involved: local authorities, the press, neighbours, agencies monitoring environmental quality (air, water), and the company's on call manager. Even if the internal situation has been brought under control, a flawed external information release could actually cause panic or confusion among local residents, or incite them to needless exposure out of curiosity; moreover, poorly informed local authorities or administrative agencies might not be able to reassure the public or prepare deployment of the resources that sometimes prove necessary (through the off-site emergency plan).

ARIA 40495 - 22 June 2011 - 69 - FEYZIN

Shortly before 9 am, strong gas smells were noticed across the Lyon Metropolitan Area, generating widespread concern and population movements. Over 1000 calls, randomly triggering 5 response procedures for a gas leak, were received by emergency services within an hour. Three victims suffering slight breathing problems had to be treated. Large volumes of calls were also recorded by the police department, town halls and the gas utility office. Many office buildings, retail establishments and residences were spontaneously evacuated. The oil refinery management sought the means to avoid a repeat of this episode and ways to improve the plant's capacity to react to odour outbreaks, which are not necessarily incidental in nature. **The authorities deplored that the information was delivered by the refinery with a delay (2 hours after the event), which did not help assuage residents' unease.**

Let's also recall that while a Seveso plant's internal emergency plan does initiate coordination with the public first responders, such is not the case for all emergency plans adopted at industrial sites. Moreover, the criteria for activating an emergency plan vary from one kind of operator to the next. Figure 3 reveals that

for incidents and accidents arising at France's Seveso plants between 2007 and 2013, the internal emergency plan was triggered no more than 1/3 of the time. Some operators are ready to initiate the plan pre-emptively even in the case of a minor incident, while others (especially those organised with a well-equipped on-site team of responders) sometimes decide not to inform public first responders in assuming that their in-house resources are sufficient to handle the situation and that the arrival of fire-fighters might complicate ongoing operations.

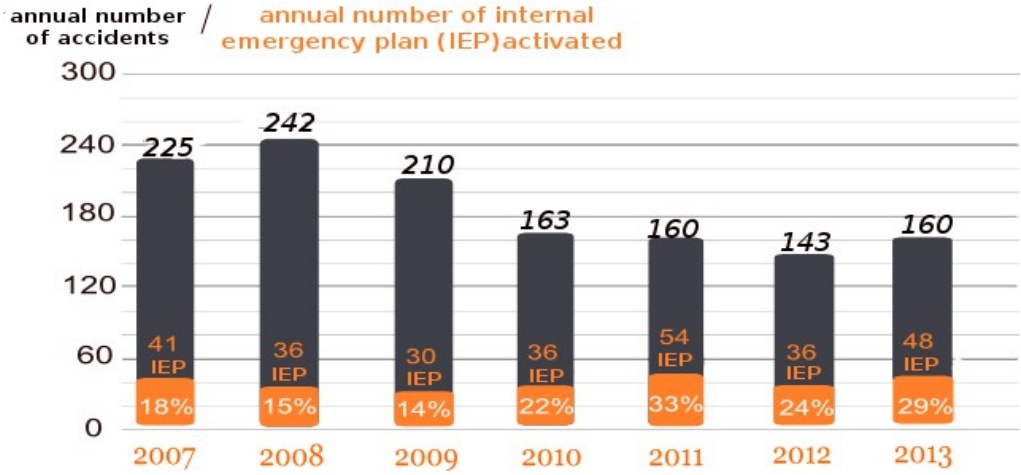


Figure 3: Rate of activation of internal emergency plans at France's Seveso plants, 2007-2013

The risk is that public fire-fighters, inadequately informed by external witnesses, arrive on the scene with inappropriate fire-fighting equipment and lose precious time in setting up and becoming familiar with the ongoing situation. In terms of best practices, it is thus critical for the plant operator to notify public emergency services as soon as he suspects an abnormal situation is turning serious, even if it is felt that internal resources can handle the challenge. Such is the premise of 12 January 2011 circular issued by the French Ministry of the Interior, which notes: "*It is preferable for the operator or his representative to inform public first responders of the occurrence and evolution of an event that has led to activating the internal emergency plan.*"

Beside accidents, this kind of coordination would be worth developing when conducting joint on-site drills. The strategy would improve public fire-fighters' knowledge of the site, its organisation, hazards and specific aspects of response equipment assigned for deployment. Above all, it would allow both parties to speak the same language as regards hazardous process and materials. The difficulties of such joint drills, however, should be underlined: availability of both parties, greater preparation time, last-minute uncertainties that may lead to the drill's cancellation, and lastly the financial participation operators must pay to public first responders in France (potentially exceeding €100,000 for a deployment of major response equipments on a large industrial platform).

Conclusion

The on-site response organisation remains an essential component of industrial facilities safety and reflects the balance struck by the operator between means of prevention and protection. Like any organisation, it presumes an effective identification of needs (risk analysis and the ensuing hazardous phenomena), rigorous preparation and a guarantee of the timely availability of both technical and human resources. While the magnitude, means employed and type of hazardous phenomena vary from one industrial plant to another, the guideline still calls for the existence of a continually-updated emergency plan, along with its associated tools (emergency instructions sheets, alert directory, facilities' plans, inventory status report) and the scheduling of drills on a regular basis.

The site's environment must also be taken into account in this organisation since an event - that may be well under control on site, yet still perceptible off site - might create confusion and needlessly trigger the deployment of large-scale public first responders. The communication aspect involving actors external to the site cannot therefore be overlooked, even though regulatory obligations remain limited in this regard.