MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE
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BARPI
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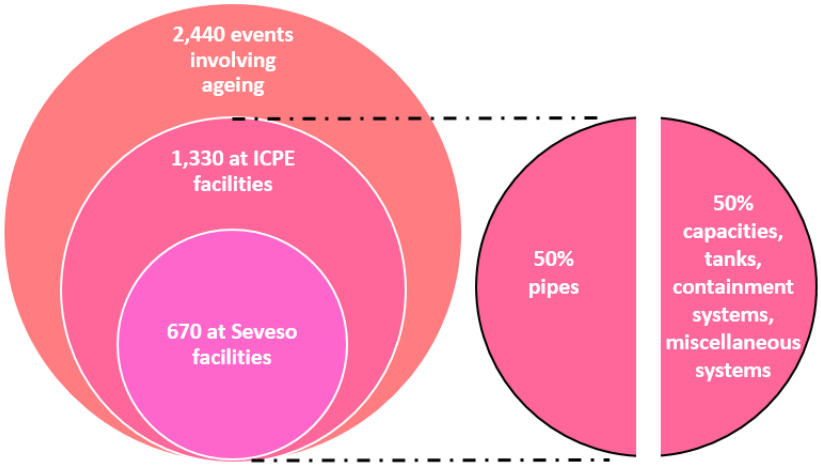
Ageing: it happens to all facilities

When the ageing of ICPE facilities (i.e., French classified facilities for environmental protection) is discussed, we often think of the PMII (i.e., French facility modernisation plan)[1]. The purpose of implementing this plan is to manage the integrity of production facilities in order to protect against technological and environmental risks associated with certain equipment and systems.

This flash takes a look at how ageing is taken into account, particularly based on three examples from the ARIA database: one affecting PMII equipment and two equipment not required to comply with this regulation. These examples reveal that, although accidents involving PMII equipment still happen, plenty happen to non-PMII equipment, too.

In addition to the regulatory scope set by the PMII regulation, analysis of the accident record clearly demonstrates that, whether required to comply with this regulation or not, ageing equipment requires special attention.

BARPI's ARIA database contains more than 2,800 events (France and abroad) involving ageing as a triggering or aggravating factor of a high-risk situation, all industrial sectors included. The illustration, opposite, provides a comprehensive breakdown of events in France, particularly affecting ICPE facilities.



ARIA 51102 – 20/01/2018 – JURA
A breach occurred in the upper section of a vertical tank 96% filled with **rainwater containing mercury** in a chemical plant. This lined 628m³ steel tank was used to collect excess rainwater. Staff detected the incident at around 04.30 a.m. during a round. 134m³ ran into the SAÔNE river with a flow of 65g of mercury. **In May 2017, an inspection of the tank had revealed it was in a degraded condition** (non-PMII tank). It had been scheduled to be shut down by the end of April 2018, i.e., allowing the time required to replace this tank with another existing tank. Pending this permanent shutdown, the tank was not disconnected so it could potentially be used to store effluent requiring storage. The tank operating instructions were adjusted (limiting of filling level to 60%) and **its use was deprioritised**.
The unscheduled shutdown of the residual water processing facility due to non-delivery of one of the reagents used by the plant, combined with heavy rain, generated an increasingly large stock of effluent. To handle this stock, **the tank was used and its filling level was then exceeded.**

The operator authorised staff **not to follow this instruction** to deal with this unusual situation.
In May 2021, another accident happened. A breach in a tank of brine containing mercury released 2.5kg of mercury into the SAÔNE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What is ageing?

Ageing of facilities is a normal, continuous, and progressive phenomenon.
It is too simplistic to associate the "ageing" of equipment solely with the notion of its age.
The properties of materials, intensity of operating constraints and conditions, and operating environment are all contributing factors that need to be known and monitored.
Managing the ageing of a facility therefore requires identification, detection, assessment and ranking of the main ageing vectors in order to take measures to mitigate, slow or eliminate them.

[1] The PMII was added to the French regulation for ICPE facilities requiring authorisation via the following orders: 03/10/2010 on storage of flammable liquids in manufactured aboveground tanks and 04/10/2010 on prevention of accidental risks.

ARIA 52654 – 23/11/2018 – RHÔNE

In a PVC production plant, when decanting was started up, a **chlorine leak** occurred on the compressor inlet gas **pipe**, **outside** the chlorine storage building. The valve was shut off to isolate the leak. White fumaroles were observed. Given the very calm wind, the cloud stagnated, then headed towards a neighbouring business that **evacuated its staff**.

According to the operator, the leak lasted 1 minute at 3 bars, causing the discharge of 5kg of chlorine. It stated that this event did not generate any irreversible effects outside the chemical platform.

The leak was from a full elbow. Localised corrosion was suspected due to the presence of ferric chloride. The pipe could have caused major accidents and **was monitored via a PMII**. The classified facilities inspectorate found that the **pipe inspection reports were incomplete**:

- they did not enable **monitoring of the thickness measurements** taken;
- the lines' **singularity points** were **not clearly identified** in the diagrams;
- the ferric chloride **mode of degradation was not identified**.


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ARIA 57492 – 20/06/2021 – ISÈRE

At around 13.40, following a storm, a **sulphur dioxide and trioxide leak** (SO_2 and SO_3) was detected visually on a sulphur acid production unit **boiler**. A white plume of smoke was discharged but remained on the site. At around 14.20, the sulphuric acid unit was shut down and the gas alert **locking down the whole site** was launched. An open head system was set up near the leak by the operator. The atmospheric readings showed nothing (business's fixed detectors, and internal and external fire service mobile detectors). At around 17.45, the plume of smoke was no longer visible. A slight odour remained on the site. The population did not feel any tingling or irritation.

The **leak** came from a **weld in the shell** with an 800m-long, 1mm-wide crack. **Six years earlier**, when a boiler bundle had been changed, **an opening had been made in the stainless-steel shell**. **Stainless steel plates** had then been **welded** on to close the shell back up. The **metal added (steel) as well as the weld penetration (1mm for 5mm) were inappropriate**. A **thermal insulation defect** contributed to the weld's **thermal shock** (via rainwater). **The shell was not subject to the regulation on pressurised devices and the boiler was not monitored via a PMII. The operator did not require welding records**. This **scenario was not studied in the site's hazard assessment**, unlike a 5mm-diameter leak following breach of a pipe causing vapour formation in the shell and requiring it to be drilled.

Analysis of the accidents in the ARIA database reveals that symptoms of ageing were often not anticipated, not detected in time, or were minimised.

The regulation cannot take account of all the specific situations on each site. Whether they result from regulatory requirements or not, they must be identified via appropriate and specific analysis.

Managing ageing has two objectives: one the one hand, a safety goal, but also an economic one due to potential unavailability.

Analysis of feedback underlines the keys to effectively managing ageing:

- **Identifying high-risk equipment or equipment contributing to managing risks**

All equipment, including utility-related equipment, must be analysed (tanks, containment systems, pipes, capacities, supports, wet gutters/trenches, instrumentation, etc.), as well as their specific points ("dead legs", brackets, supports, protective coverings, welds, ground input/output, etc.). Access issues must not disrupt identification and subsequent controls;

- **Knowing equipment and monitoring its changing condition**

The equipment's maintenance log must be available: design data, materials, operating conditions, potentially aggressive environment, maintenance and monitoring history, feedback data on comparable / similar equipment;

- **Detecting ageing vectors and knowing how to analyse them**

Too many events happen due to late or unanticipated detection, even though the operator detected weak signals. Knowing the equipment and monitoring its changing condition must enable possible degradation mechanisms and kinetics to be determined. Inspections (internal and external), monitoring of parameters characteristic of ageing as well as reliability indicators must be put in place so that degradations do not worsen, causing equipment to malfunction;

- **Taking measures to mitigate, slow or eliminate ageing vectors**

The controls carried out must be appropriate. This means choosing the right methodology but also the right equipment. Then, care must be taken when interpreting results to ensure that the frequency of controls, repair/replacement deadlines, choice of continued use or operating condition changes are appropriate. Modifications to equipment and/or processes can enable, after detailed risk assessment, improvement of not only the robustness of the facility against the effects of ageing but also improvement of monitoring work.