MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE ET SOLIDAIRE

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Startup/restart or shutdown operations: heightened vigilance

Startup, restart and shutdown operations are critical phases during which technical malfunctions can have far-reaching consequences. Most of the time, these phases are system-controlled, and the technicians can implement compensating measures, as required, depending on the processes involved. The challenge is to remain particularly alert in order to avoid accidents that could injure workers or destroy the equipment or facilities.

Startup/restart operations, whether they are carried out manually or in an automated manner, must be performed when all safety conditions are in place, despite any possible production constraints, so that the personnel can perform their tasks with complete peace of mind. The installations must be shut down in a controlled manner when required. Special measures for startup/restart operations must be put in place, notably in terms of checks, procedures and oversight. The examples presented below illustrate instances where the control of the installation has been lost during startup/restart or shutdown phases. The consequences are often critical for the personnel (injuries), for the sustainability of the installations (operating losses, significant equipment damage) and for the environment if pollution occurs (waste management, decontamination).

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ARIA 54897 – 12/12/2019 – CÔTE-D'OR: *30 t of soybeans lost when a dryer is started (soybeans excessively humid at the reception point)*

Critical phases to be studied in risk analyses

French circular of 10 May 2010: *Risk analysis, a process that helps identify and reduce risks, is carried out under the operator's responsibility. […]. It relates to all possible operating modes of an installation, including the* ***transitional phases, foreseeable interventions or modifications likely to affect safety, and possible degraded operations****. The greater the risks or hazards, the more in-depth the risk analysis will be.*
Accidents that occur during shutdown/startup/restart phases remind us how important it is to take these steps into account in risk analyses (notably PHA and FMEA) and in danger studies for establishments subject to authorisation (*ARIA 49760, 54955*). It is also essential that they be reviewed within the framework of the actions carried out following an incident/accident (*ARIA 51446*).

ARIA 49548 – 14/04/2017 – RHÔNE

At around 1:15 a.m., an explosion occurred in the feed hopper of a furnace **in a household waste incineration plant.**

At the time of the accident, the incineration line was in the **shutdown phase** in preparation for two weeks of technical maintenance that was scheduled to start the following morning. The last batch of waste had been fed into the hopper at around 11 p.m.

The operator had noticed several problems shortly before the explosion:

- The draught fan, supplying oxygen to the combustion chamber, had lost power several times. These power outages shut off the auxiliary gas burners used to maintain the flue gas at a temperature at 850 °C, as required by regulations.
- The temperature of the water circulating in the shell surrounding the bottom of the hopper had risen to 160 °C. Under normal conditions, the water is 40 °C.

The accident occurred during a holiday period when only a limited number of crews were present on site.

ARIA 48676 – 10/10/2016 – BOUCHES-DU-RHÔNE

A gas boiler exploded at 11 p.m. **during a restart** in a steel plant. **The boiler had just been placed back into service after an extended maintenance shutdown period following a series of events in early 2016 (ARIA 47992 and 48395)**. The plant's operation was hindered for several weeks.

After several attempts by the day shift foreman to light the boiler, the night shift foreman also attempted the operation unsuccessfully. On the 10th attempt, he decided to shunt the flame detection sensor on the 1st, then the 2nd burner, and initiated the 3rd to bypass the pre-ventilation phases in the event of non-detection. The gas injection flow rate thus created a volume of approximately 90 m³ of propane when the 3rd burner ignited, forming an ATEX (potentially explosive area), which caused the explosion.

The facility operator identified several root causes of this accident:

- **the shift foreman was alone when the decision was made: night shift, assistant in training;**
- **a high level of stress in the workplace owing to the degraded operation of the facilities over the last few recent weeks;**
- **underestimation of the risk;**
- **the shunt of the flame safety devices was not sufficiently secure.**

To avoid this type of accident, the operator modified the procedures for testing igniters and reinforced safety measures to limit the shunt of the flame detection sensors at the burners.

ARIA 52384 – 07/10/2018 – LOIRE-ATLANTIQUE

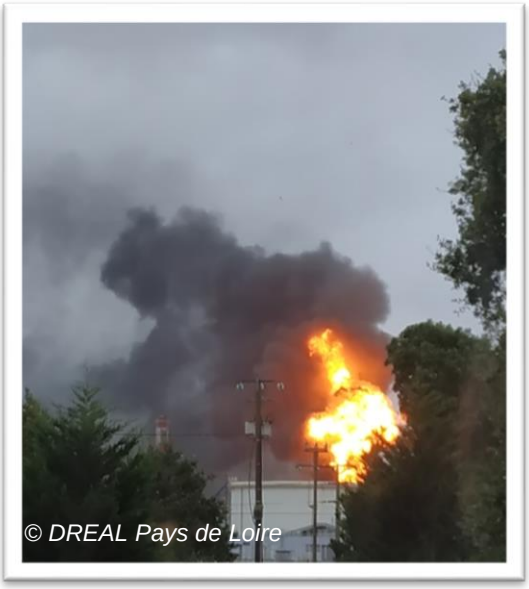
At 10:58 a.m. in a refinery, liquid diesel fuel ignited on a flare outlet **while the diesel fuel production unit was being restarted**.

The accident occurred shortly after the production unit was connected to the flare network. Following an overflow on a dryer vessel, the diesel fuel was sent to a buffer tank upstream from the flare. Both of these devices are equipped with high-level alarms. The alarms sounded but were not followed with actions (automatic or manual). The facility operator identified several malfunctions:

- **the technician assigned to these operations was having to handle major problems** on another unit at the same time. Consequently, he did not notify his shift supervisor, who was busy with other duties;
- although identified as an essential safety barrier, the technician did not correctly interpret the high-level alarm on the tank owing to his high stress;
- **incomplete procedures:** the procedure for restarting the diesel fuel unit was unclear regarding the steps required to start the dryer vessel, and the procedure for managing alarms did not include acknowledgement instructions.

The operator took various actions following the accident:

- the restarting procedure was elaborated;
- **the ergonomics of the overview panels was improved to facilitate the detection of abnormal situations** and an extensive project was initiated to improve alarm management.



Large flames and a plume of black smoke were visible from afar.

In the majority of cases, the study of accidents occurring during startup/restart/shutdown phases reveals organisational causes: Inadequate procedures, insufficient controls and a lack of training are frequently involved. These factors must be thoroughly investigated so that such accidents can be avoided. With that in mind, **a few recommendations** can be made:

- ✓ **Ensure that appropriate procedures are in place:** when shutting down facilities (*ARIA 52625*), in a degraded situation (*ARIA 46760*), when restarting following work (*ARIA 50641, 48569*), in the event of incidents or after modifications (*ARIA 42817, 48830*). Once the procedures have been validated, check that they are understood and train the personnel, including the subcontractors, in how to apply them (*ARIA 50339*);
- ✓ Consolidate and strengthen the tracking of the **modifications made** to the installations during the shutdown, before restarting (*ARIA 51172*) and modify the operating procedures accordingly;
- ✓ **Improve the management of alarm bypasses or shunts:** lockout/removal of lockout during works (*ARIA 50636*), risk analysis during placement (*ARIA 49094*), compensatory measures if provided for during shutdown/restart phases;
- ✓ **Reinforce controls before restarting** (*ARIA 50339, 48841*);
- ✓ **Train employees** on the specific shutdown/restart-related risks (*ARIA 49821, 47654*);
- ✓ Organisation of the work: **ensure the presence of competent** personnel (*ARIA 49087*) and **supervisors** available (*ARIA 52092*) during these critical phases. These phases are not to be performed during off-peak periods (i.e. at night or on weekends) to ensure **that reinforced surveillance is available** (*ARIA 54488*);
- ✓ Ergonomics: **identify the critical parameters and equipment** required during these phases and ensure that they are legible and easily accessible on the mimic panels in the control room (*ARIA 48831, 51230, 52384, 54865*);
- ✓ **Check the process control relaying before restarting:**
  - Manage the functions in manual mode (*ARIA 52837*), see also: actuator summary;
  - Ensure the proper configuration of the installation (*ARIA 50755*), see also: configuration summary;
  - **Reinforce the safety barriers for this phase** (*ARIA 52592*) ;
- ✓ Give special consideration to the equipment used and its positioning (*ARIA 40092, 49575, 52837*).