

# Leak of sulphur containing gases in a refinery

## 1 march 2018

### Grandpuits (Seine-et-Marne)

### France

Safety culture  
 Communication  
 Internal emergency plan  
 Preventive maintenance

## THE ACCIDENT AND ITS CONSEQUENCES

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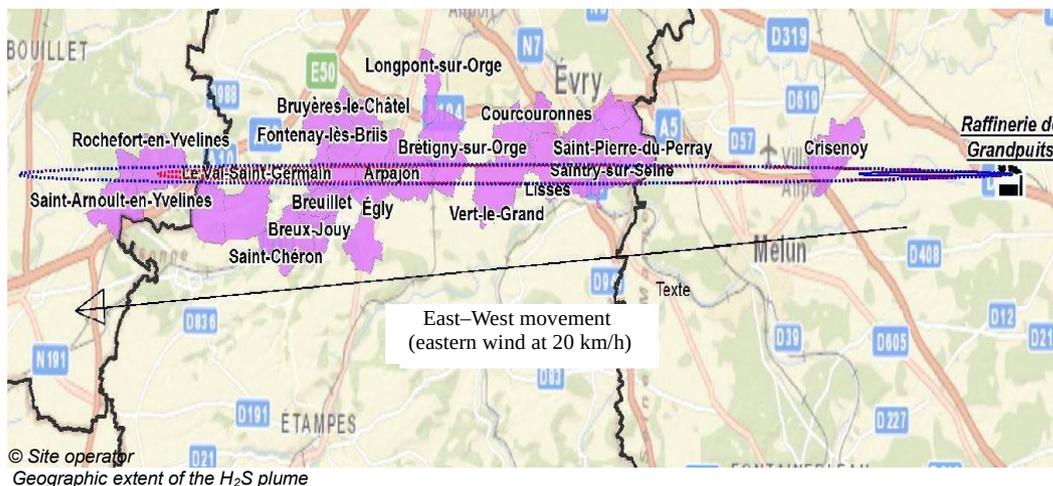
At around noon, the operator of the Grandpuits refinery, an upper-tier Seveso facility, confirmed that a leak had occurred on a check valve of a unit used to purify sulphur containing gas and that the leak had been stopped 30 minutes earlier. The gas primarily consisted of hydrogen sulphide (H<sub>2</sub>S), which is toxic, flammable, and has a pungent odour at low concentrations.

The refinery's internal emergency plan was implemented at around 2:00 p.m. and a team from the Regional and Interdepartmental Directorate for the Environment and Energy (DRIEE) was dispatched to the site. The operator indicated that no alarm had been triggered by any detectors and this appeared to be corroborated by the shift log. However, information provided by the operator afterwards showed that in fact 25 alarms had been triggered (10 ppm of H<sub>2</sub>S) at the start of the leak and that two of them were high-threshold alarms (40 ppm of H<sub>2</sub>S). The unit's operating crew searched for the leak without informing anyone else at the refinery. As a result, neither the refinery's safety department nor the department supervisor provided satisfactory answers when contacted that morning by the rescue service.

## THE ORIGIN AND THE CAUSES

An analysis of the event showed that the leak occurred on a valve on the gas line between the purification column and the gas-flaring system. It was found that the valve's cap had been distorted by ice (outdoor temperatures below -5° C). During normal operation, the gas contained in the line does not flow. Heat tracing is used to prevent the formation of condensation, but the operator noted that it was not working. The expansion of the ice caused a crack to form in the valve. This crack then allowed the gas to leak out when the ice thawed. The lack of insulation and the fact that the valve was positioned at the bottom contributed to the build-up of water in the valve.

An estimated 187 kg of gas was released. The icy temperatures, strong wind, and atmospheric stability that remained very high throughout the event and the area explain why the odour was noticed in three counties. Computer models and air-quality measurements taken near the site show that the H<sub>2</sub>S concentrations were very low (less than 1 ppm) and thus there were no offsite toxic effects. However, the significant lethal effect thresholds<sup>1</sup> may have been exceeded in some areas near the leak inside the refinery.



1. 414 ppm and 1720 ppm for 60 minutes and 1 minute of exposure, respectively.

## FOLLOW-UP ACTION TAKEN

In addition to the ice-induced damage to the valve, significant shortcomings on the operator’s part prevented on-time detection of the leak, placement of the refinery in a safe state, and implementation of its internal emergency plan. After the analysis of the event, the operator proposed technical and organisational safeguards to prevent a similar accident from recurring. More particularly, it checked and reinforced the refinery’s heat insulation and heat tracing systems. It also lowered the H<sub>2</sub>S detection thresholds to 5 and 10 ppm in order to speed up the localisation of leaks.

In terms of incident management, communication, sharing of information, and procedures specifying actions to be taken in the event of H<sub>2</sub>S leaks were revised and presented to all the operating personnel. Procedures on triggering the internal emergency plan were also revised and supplemented with an odour-detection scenario sheet. Lastly, the reporting of information to the authorities was consolidated.

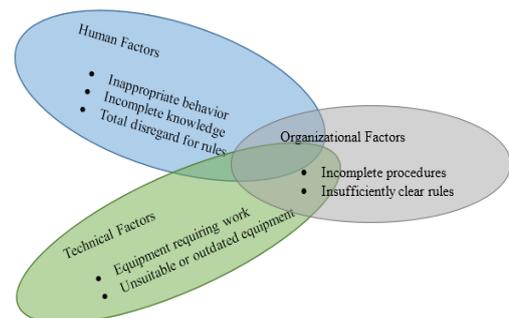
## LESSONS LEARNT

It is important to point out that the event was one of a long string of incidents. In fact, ten incidents of various types had already occurred at the site between 2017 and 2018. Following this latest incident, the operator was summoned by the subprefect of the Seine-et-Marne county and then by the director of DRIEE to explain why the incidents had occurred. Both asked about the technicians’ training, their safety culture, the organisation of operations, and management’s involvement in maintaining a true safety culture at the refinery. The operator stated that the safety culture at the refinery had been assessed in 2017 by an independent organization (ICSI) and that the assessment was based in particular on a questionnaire sent to all the refinery’s employees and contractors. Presented during a meeting of the refinery’s corporate committee for health, safety, and working conditions (CHSCT), the assessment revealed a number of alarming findings:

- too-little focus on major risks;
- normalisation of deviance, particularly in relation to major risks, with a focus on productivity that is sometimes detrimental to safety, and little regard for initiatives and suggestions;
- declining confidence in the technical base of the work and a loss of meaning for those performing the work;
- leaders who are rarely in the field;
- management mostly gives orders and rarely participates;
- strong inertia at interfaces between functions and departments;
- insufficient culture of transparency.

Deficiencies in communicating information about incidents to external parties were also found and appeared to corroborate a certain carelessness or at least a lack of focus on safety.

Lastly, the investigation showed that technicians inadequately understood basic safety rules despite thinking that they were following them and that technicians continued performing operations even if they did not go as planned (fear of being singled out as responsible for abnormal situations and for losses in site efficiency). In addition, half the refinery’s technicians stated that they preferred to keep silent about safety incidents out of fear of being punished. Employees no longer gave managers feedback because they feared bothering them and, because of a lack of responsiveness and pragmatism, have little motivation to take part in the process.



© Site operator  
 Characterisation of the root cause behind various incidents

Following this assessment, a programme was launched to improve the safety culture at the refinery, focused on human and organisational factors. Using feedback from employees, the refinery’s management committee proposed four areas of improvement:

- create conditions for enforcing workplace rules that are understood and followed by all;
- build an approach focused on the greatest risks for the site;
- develop safety leadership based on the exemplary behaviour and commitment of all;
- recognise performance.

All four have been passed down to four cross-disciplinary working groups made up of employees from all departments and levels of management. A call for volunteers garnered a pool of 30 candidates. A concrete action plan is expected to be developed to identify avenues for improvement for each area and thus improve the refinery’s safety culture by 2020.