

# Release of liquid and gaseous hydrocarbons by the valves of the atmospheric distillation tower of a refinery

7 August, 2005

**La Mède – [Bouches du Rhône]  
France**

Accidental release  
Refinery  
Atmospheric distillation  
Hydrocarbons  
Start-up  
Valves  
Alarms  
Human and organisational factor  
Overfilling of unit

## THE INSTALLATIONS IN QUESTION

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### Site:

The facility concerned is located since 1935 in the La Mède site between the towns of Châteauneuf-les-Martigues and Martigues, on the southern banks of the Berre lake at about 40 km to the west of Marseille. The site covers 250 hectares in the lower part of a rocky dale open to the east. This refinery has an annual crude oil refining capacity of 8 million tonnes. It converts crude oil into fuels (LPG, petrol, gas oil, kerosene), domestic and industrial fuel oils and also manufactures non-energy products such as sulphur, road asphalts, high-gravity gasoline (naphtha) and propylene. This facility mainly includes all standard crude oil refining units (atmospheric distillation, vacuum distillation, catalytic cracker, catalytic reforming, isomerisation, and alkylation).

### Unit involved:

The unit involved in the accident is the C1 atmospheric distillation tower commissioned in 1968 and located in the eastern side of the refinery.

Crude oil enters the main tower of the unit at a temperature of 380 °C. It is then refined and divided into 6 main fractions ranging from the heaviest by-product exiting from the bottom of the tower to the lightest product exiting from the top of the tower.

The atmospheric distillation tower is fitted with five safety valves whose released waste is not recovered by the flare network.

## THE ACCIDENT, ITS BEHAVIOUR, EFFECTS AND CONSEQUENCES

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### Background:

The units in the eastern sector have been de-commissioned since 27 July 2005 due to a social conflict. The resumption of operations was decided by the staff on Saturday 6 August in the morning. The various units were all re-started at the same time.

The operating procedures used on site are of the "Operguid" type. Since the unit was not drained during its shutdown, it was started as per the "on level" procedure.

### Accident:

On 07 August 2005 at 4.46 p.m., the valves of the atmospheric distillation tower opened causing the liquid and gaseous hydrocarbons to be released from the top of the tower for 5 minutes.

Since the facility was stopped "on level", crude oil was already present in the tower at 50% of its maximum level at the bottom of the tower.

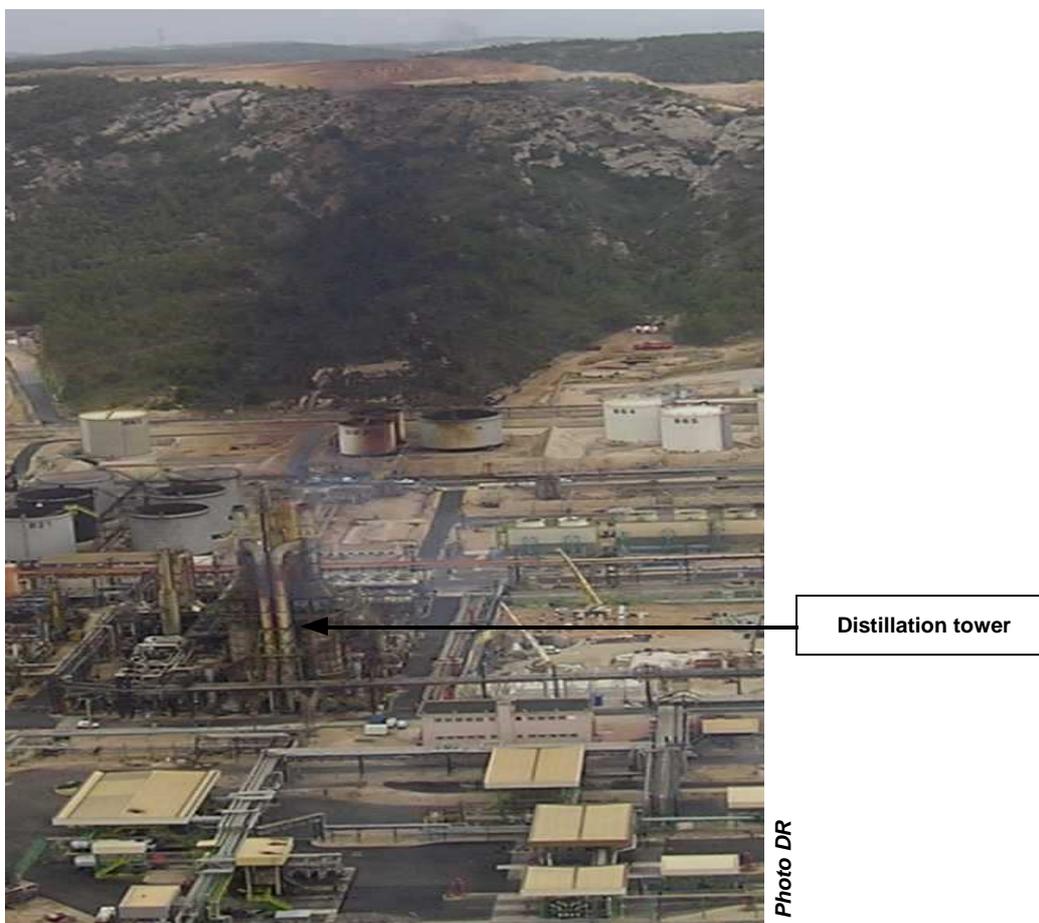
The unit start-up took place in several steps: the first step involved cold re-circulation of crude oil in the unit, i.e. the crude oil is pumped from a tank and circulated in the entire circuit including the distillation tower and different equipment (balloons, etc.) and sent back to the same tank.

After inspecting the various equipment of the same line, preparing several parts of the tower for operation and numerous inspections, the technicians switched on the furnaces to heat the crude oil. The C1 tower and its sidestream drums are filled subsequent to the slightly higher injected flow rate in the circuit as compared to the extracted flow rate towards the tank. Since the hot product occupies more volume than the cold product, the pressure in the C1 tower exceeds the valve loading values, causing the valves to open and release a mixture of liquid and gaseous hydrocarbons made up of crude oil and other distillation products such as gas oil, LPG, etc.

### Consequences:

The opening of the valves led to the release of about 10 to 20 tonnes of liquid and gaseous hydrocarbons into the atmosphere (pressure greater than 3 bars and temperature at about 300 °C) and a superficial pollution of the soil and vegetation that spread south due to windy conditions to the village of Sausset-les-Pins situated 7 km away. There were violent winds from the north blowing that day.

Note that the "cloud" floated past one of the two flares of the refinery.

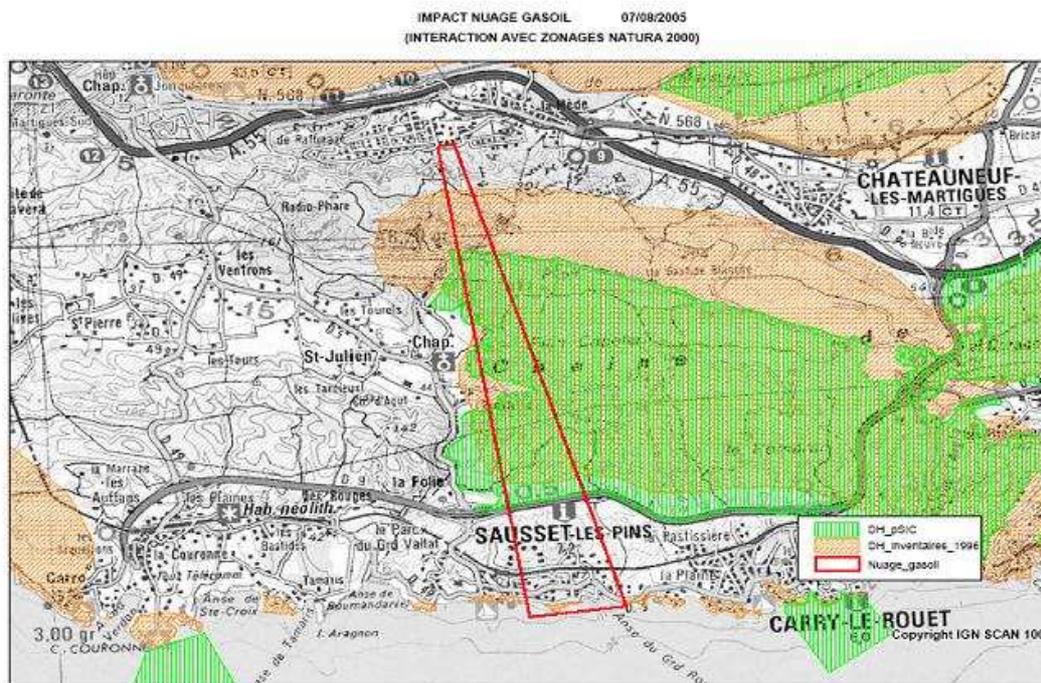


General aerial view of the unit and traces of spill in the neighbouring environment.



Photo DR

General aerial view of the unit and traces of spill in the environment south of the site



The Inspection of Classified Facilities was informed of the incident by the health authorities and the residents of Sausset-les-Pins, and not by the operator who was unaware of the consequences.

The 70 children in a youth camp were required to stay indoors and seven among them were examined by a doctor.

Some people were affected by the released product and one person was hospitalised.

Numerous houses (563), cars (726) and swimming pools (132) were polluted by the hydrocarbon fallout.

### European scale of industrial accidents:

By applying the rating rules of the 18 parameters of the scale made official in February 1994 by the Committee of Competent Authorities of the Member States which oversees the application of the 'SEVESO' directive, the accident can be characterised by the following 4 indices, based on the information available.

Dangerous materials released		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human and social consequences		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environmental consequences		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Economic consequences		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The parameters that comprise these indices and the corresponding rating method are available at the following address: <http://www.aria.ecologie.gouv.fr>.

The index concerning the release of dangerous materials is set at level 4 as between 10 and 20 tonnes of hydrocarbons made up of extremely inflammable liquids as defined in part II of appendix 1 of the Seveso directive (top tier 50 tonnes) were released during the incident (Q1 parameter).

The social and human consequence index is set at 3 as 8 members of the public were affected including one of them was hospitalised (H5 parameter).

The environmental consequence rating is set at 3, the clean-up operations were carried out over a surface of 9 hectares (Env13 parameter).

The economic impact of the incident including clean-up of houses, swimming pools, cars, etc. by the operator is estimated between 2 to 10 million euros. The production losses that are higher than 2 million euros explain the level 3 attributed to the economic consequences index (parameter € 16).

## **ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT**

This accident mainly resulted from:

- a series of incidents involving the incorrect application of the start-up procedure resulting in a loss of indicator level control in the distillation tower and in the lateral strippers making it more difficult to monitor the unit during this delicate phase.

None of the control systems were able to indicate this anomaly which was repeated during four successive shifts.

The procedure clearly stated that the level at the bottom of the atmospheric distillation tower must be at 50% of its maximum level, which was the case at the start of operations.

The tower was gradually filled due to the slight positive difference between the deliveries of the loading and unloading pumps during recirculation from the crude oil tank to the distillation tower and return to the crude oil tank.

It is to be noted that once the level reached at the bottom of the tower is 100%, the operator no longer has direct access to information on the effective level of liquid in the tower. He only knows that the bottom of the tower is full up.

During a shift, an operator lowered the level in the tower to 50%, but the tower was gradually filled up again.

- poor traceability of the operations performed and relay of information from one shift to the other.

In fact, implementing an accident prevention policy and the resulting safety management system must lead to the application of operating procedures to avoid such accidents.

- in compliance with the prefectural authorisation order providing for the recovery of waste released by valves by the flare network or an equivalent solution if technically not feasible.

- ignoring alarms and absence of an automatic safety device control. In fact, the atmospheric distillation tower level indicator only triggers a visual and sound alarm relayed to the control room when the threshold value is exceeded.

Moreover, the operator did not inform the public, the Prefect and the Inspection of Classified Facilities of the incident as soon as possible; the operator himself realised the consequences of the accident after an hour.

## ACTIONS TAKEN

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The Inspection of Classified Facilities visited the site on the day of the accident.

Three other inspections took place in the 15 days that followed.

Inspections were also performed on the four other refineries in the south east of France with a view to minimise the risk of reoccurrence of such an accident and to understand the organisation currently used to start-up units on other sites.

The following points were mainly reviewed:

- Number of valves present on the atmospheric distillation tower whose released waste is recovered;
- In the procedure used: presence of spot points, check list, required initial state, effort made in completing the follow-up documents;
- organisation of the control room;
- organisation of the teams working in shifts;
- training of staff working in shifts;
- specific start-up requirements (example: provision of additional staff, etc.);
- presence of detectors and follow-up systems;
- information in the shift supervisor's manual;
- information in the technician's manual.

The facility resumed operations on the day following the incident.

The operator set up two safety lines:

- high pressure sensor in the tower with immediate stop of the furnace and the load after a 10 minute timeout compatible with the valve loading pressure;
- sensor monitoring the filling of the tower with immediate stop of the furnace and the load after a 10 minute timeout.

The ergonomic design of the control room was changed (the units were brought together by the control panel) and the teams working in shifts were reorganised.

The question of connecting the valves to the flares was studied at all refineries in France. Since then, this has been carried out at the site.

The ecological impact study showed that the release of hydrocarbons had no lasting impact on the flora and fauna.

On 8 June 2007, the operator was ordered by the police court to pay three fines of a cumulative value of 10,250€.

## LESSONS LEARNT

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Besides the human factor that played a major role in this accident, a failure of the Security Management System was also brought to notice resulting in the following changes:

- Proper completion of follow-up documents for operating procedures
- Improvement of communication during change of shifts
- Setting up of safety control systems to avoid belching of the tower
- Reorganisation of the control room and the teams in shifts
- Connection of valves to the flare network
- Assessment of the risk of belching in danger studies

This feedback providing a wealth of information was shared with the other refineries in France.