

Fuel oil spill in an estuary during a transfer operation

16 March 2008

Donges (Loire Atlantique) France

Leak
Refinery
Pipe network
Fuel oil
Ageing
Corrosion
Maintenance
Pollution cleanup

THE FACILITIES INVOLVED

The site:

The Donges refinery, offering an annual distillation capacity of 10 millions tonnes of crude oil, is located on the northern bank of the Loire River at the river's edge in the vicinity of an expansive wetlands zone, comprising the mouth of the Loire and its adjoining marshland. This zone features a series of highly-diversified media with mudflats, reed beds and floodplain meadows being considered as exceptional here in terms of both flora and fauna.

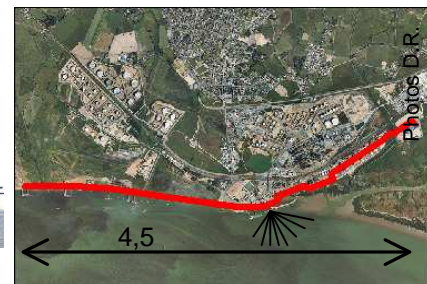
This refinery produces, from crude oil supplied by boat, an entire array of typical petroleum products (including LPG, kerosene, gasoline, diesel, domestic fuel oil, bitumen and naphtha).



The involved unit:

The leak occurred on a pipe approximately 4.5 km long connecting a cargo fuel oil storage tank to a ship loading station.

At the leak point, the rack supporting the defective pipe runs parallel to the gas storage zone at the periphery of the Loire River banks over a length of some 300 m.



THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

The accident:

While loading an oil tanker at the refinery wharf, on a Sunday afternoon, a corroded pipe began to leak and caused 478 tonnes of cargo fuel oil to spill for 5 hours, leading to a major pollution incident on the Loire River estuary and extending to the wider coastal zone.

This leak was only detected at the very late in the afternoon and thanks to the vigilance of the crew on a barge moored at another wharf about 400 m downstream of the leak point.

The Internal Emergency Plan was activated and a crisis team assembled by the Prefecture. Significant resources were allocated to both land and aerial surveying.

Shortly thereafter, a pellets collecting ship was deployed at the mouth of the river as well as two trawlers equipped with special nets for collecting hydrocarbon pellets in the estuary. Booms were also set up in order to recover supernatant hydrocarbon.



Consequences of this accident:

Environmental impacts:

Exposed to the effect of tides and currents, the fuel oil dispersed onto the northern and southern shores of the Loire estuary. Hydrocarbon pellets were recovered on beaches in the neighbouring Vendée Department and as far south as the Isle of Rhé. Pollution cleanup efforts, in some cases requiring mobilisation of up to 750 personnel all at the same time, lasted three and a half months to clean not only some 60 km of fouled riverbanks, but also wetlands further inland (swamps, reed beds, etc.).



Public access restrictions were issued for certain beaches and fishing holes in the estuary; they would gradually be lifted between April 4 and 18, 2008.

The assessment of extent of impact on the flora and fauna was promptly initiated by conducting from the outset an accurate inventory of the detrimental effects to birds. Biweekly observations recorded by the National Office for Hunting and Wildlife revealed that the number of bird deaths caused by this pollution spill was less than 10 throughout the entire Loire-Atlantique Department.



The proportion of soiled birds kept decreasing as pollution cleanup progressed, with the affected bird population gradually leaving the zone as time went by.

Nonetheless, several tens of dead animals were recorded in both the Vendée and Charente-Maritime Departments over the following days, even though no scientific causality correlation could be established, especially given the type of species involved.

The operator provided most of the manpower and assumed financial responsibility for all damages, pollution cleanup costs and compensation paid out to injured professionals (with a total price tag of around €50 million).

Potential health impacts:

After an initial inspection conducted by a State agency on the morning of March 17, a set of health-related recommendations (i.e. how to avoid contact with the product due to its toxic nature) were broadcast via press release, transmitted to elected officials, and uploaded to the Prefecture's Website. Information bulletins on product composition, the carcinogenic potential of some of its ingredients, associated risks and precautionary measures to be respected were regularly broadcast as a follow-up step, depending on the results of analyses available regarding product characterisation as well as water and shellfish quality. Protective measures prohibiting professional and recreational ocean fishing were enacted by Prefecture order dated March 18.

Calls for prudence were posted on all beach access points, which remained open to the public, and disseminated to local town halls on March 21. Sampling campaigns on seawater and shellfish got underway on March 19 and all ensuing results were made public.

In response to complaints received by residents from the town of Paimboeuf, which was hardest hit by the spill, doctors were on call as of March 19 to identify eventual acute effects related to the pollution, yet no consultation was recorded for health problems attributable to this spill. According to the Interregional Epidemiological Cell (CIRE) with France's Public Health Surveillance Institute (InVS), short-term exposure to low concentrations of volatile compounds could be dismissed as a subsequent cancer risk for residents in the vicinity of the spill.

The European scale of industrial accidents:

By applying the rating rules applicable to the 18 parameters of the scale officially adopted in February 1994 by the Member States' Competent Authority Committee for implementing the 'SEVESO' directive on handling hazardous substances, and in light of the information available, this accident can be characterised by the four following indices:



The index relative to "environmental consequences" was given a 5 rating due to the 60 kilometres of fouled riverbanks that required intensive cleanup efforts (parameter Env14).

The costs of cleaning and decontaminating the affected media, in excess of €20 million, explain the 6 rating assigned to the "economic consequences" index (parameter €18).

The "hazardous materials released" index was not rated, since the cargo fuel oil spilled is not a material listed in Appendix I of the Seveso directive.

Due to the lack of information available on the number of third parties involved in the working restrictions issued following the accident (for industries using the ocean), the "Human and social consequences" index could not be ascribed a value either.

The parameters composing these indices and their corresponding rating protocol are available from the following Website: <http://www.aria.developpement-durable.gouv.fr>

THE ORIGIN, CAUSES AND CIRCUMSTANCES SURROUNDING THE ACCIDENT



The defective pipe, 12 inches in diameter and lined with thermal insulation, was included in a group of facilities composed of some 20 pipes on two levels. An examination of the defective pipe section revealed the presence of a longitudinal crack approximately 16 cm long by 1 cm wide adjacent to observed local corrosion underneath the thermal insulator lining. Water flowing from a perforated pipe, positioned vertically with respect to the fuel oil pipeline, infiltrated under the leaky thermal insulation, first causing the steel to corrode and then perforating the pipe.

A pipe verification and maintenance programme was adopted for the refinery site in accordance with a procedure developed in April 2007 and designed to establish the various inspection and maintenance periodicities depending on the type of pipe configuration and potential vulnerabilities.

The importance of conducting maintenance specifically devoted to the pipe where the leak could be traced was however poorly evaluated in this programme, despite a number of warning signs picked up over the preceding months on this particular group of pipes and despite the potentially serious consequences that an accident could trigger for an individual pipe given its proximity to the riverbank.

The main flaws committed by the operator due to this incorrect analysis pertain to two types of actions, as follows:

Preventive and remedial maintenance of the pipes:

Several observations noted by the operator between 2004 and 2007 should have led to detecting, as part of site organisation, a potential risk with respect to the structural integrity of this heat-insulated piping:

- 7 observations of vapour leaks recorded during 2006 and 2007 on the defective rack and on an adjacent identical line, suggesting the possibility of an accelerated corrosion phenomenon at this particular site;

- The most recent visual inspection of all thermal insulation on the lines yielded, in October 2004, a total of 27 points where the insulation was found to be either out of service or deficient. This examination convinced the operator to initiate a replacement programme for a portion of the refinery's thermal insulation during years 2005 and 2006, although the replacement specific to the damaged pipe section was not scheduled until between May and September 2008. Moreover, no document on overseeing the schedule of these replacement tasks and no reasons for discontinuing the insulation replacement programme in 2006 were furnished to the classified facilities inspection authorities;
- 14 requests for service in response to a water pipe leak on the rack were received as of November 2005, without initiating a more detailed analysis regarding the potential consequences on pipes running vertically below.

Control of ship loading operations:

Ship loading operations were verified using solely the measurement of pressure present on the damaged pipe (service pressure: 12 bar). This measurement was positioned downstream of the pump that conveys product into the pipe and likewise downstream of the leak. Consequently, the small pressure variations recorded in the control room were insufficient to enable notifying the team of technicians responsible for loading operations.

ACTIONS TAKEN

Onsite:

Following both the field visits performed in the hours just after the accident and the initial set of conclusions drawn from the refinery's own internal investigation, several protective measures were implemented, namely:

- permanent monitoring from a manned station set up on the path of the pipe network running alongside the Loire;
- definitive shutdown of operations on the defective fuel oil pipe network;
- visual inspections and thickness controls at the level of special network points (braces, tapping points, etc.) after thermal insulation removal on lines over the entire rack length alongside the Loire;
- displacement of the service water pipe route in order to prevent it from aligning with any of the thermally-insulated lines of the rack running alongside the Loire.

Moreover, implementation of several technical and organisational improvement measures had been prescribed by Prefectural order, i.e.:

- Throughout the site:
 - extension of the inspection schedule to both liquid hydrocarbon and chemical product lines, in incorporating their criticality with respect to environmental risks;
 - formalisation of identification and treatment campaigns for degraded thermal insulation;
 - formalisation of the procedure for repairing leaks on utility lines (particularly water and steam networks);
 - specifications and allocation of remote detection equipment adapted to the various products and sensitive zones.
- Specific to the pipe rack responsible for the accident:
 - modification of the ground lying beneath the rack, for the purpose of draining any eventual flow in the direction of a gutter connected to the refinery's oily water pipe network, thus preventing new leaks from polluting the Loire;
 - installation of a detection system for all types of leaks by means of instituting permanent monitoring of all pipes located in the vicinity of the Loire; such a system is configured using thermal cameras coupled with an image management system and relay of any anomaly to the control room. This set-up is completed by a leak detection device at the level of the gutter, in case a leak were to arise beyond the field of vision of this thermal camera system;
 - monitoring of product transfer operations by any means so as to ensure that quantities conveyed to the reservoir are actually received at the other end of the pipeline.

The inspection campaign carried out on all aboveground pipes positioned on the banks of the Loire entailed 120 pipe sections and consisted of more than 8,100 ultrasonic thickness measurements following thermal insulation removal on the inspected sections.

The results of this campaign revealed:

- on 5 sections, significant thickness losses due to external corrosion, necessitating repairs;
- 2 point-specific defects due to internal erosion on elbows of condensed water lines.

In addition to these defects, various tasks, including restoration of pipe lining and replacement or repositioning of pipe supporting braces, have been scheduled.

Offsite:

Monitoring of the health and environmental impacts of this pollution incident was assigned to a scientific committee composed, among others, of State agencies, specialised services, environmental protection associations and a public interest consortium responsible for sustainable development issues related to the estuary.

This committee was asked to advise Prefectural authorities in their response to the environmental impact assessment of such a pollution outbreak as well as in the resources to allocate for remedial action. This advisory body first served to inform associations of the magnitude of the incident and the initial measurements undertaken; the next step involved issuing a ruling on pollution cleanup methods so that the anticipated techniques were able to preserve the estuary's vulnerable habitat. The committee's final duty was to set forth cleanup action priorities on behalf of the bird population, in addition to a request to produce the set of specifications for a study mandated by the site operator, via an order dated July 29, 2008, relative to valuing both ecological damage and site restoration costs.

In all, 451 tonnes of fuel oil were recovered, i.e. 93% of the total pollution volume (6,200 tonnes of waste material), of which approx. 180 tonnes were spilled into the Loire.

The wastes composed of recovered fuel oil, along with the fouled flora and soils (66% in tonnage terms) and materials dirtied during cleanup, were all to undergo treatment within authorised facilities. The fuel oil and plants were incinerated, while fouled soils were biologically treated and then used at a final waste storage centre.

Communication efforts:

An information and communication system devoted to the various actors involved in this process was introduced.

This system comprised:

- a daily press debriefing from the crisis cell coordinated by the Prefect,
- creation of a cell assigned to distribute compensation to pollution victims,
- organisation of regular meetings with local elected officials and associations,
- constitution of a local information commission on estuary pollution risks (built around exchanges and information dissemination).

LESSONS LEARNT

The lessons drawn from this accident pertain to the need for a global approach not only aimed at improving prevention, but also at detecting as early as possible potential leaks so as mitigate their impact, without overlooking the organisation of intervention and remedial measures should the accident still occur despite precautions taken:

1/ Prevention measures:

- The importance of monitoring corrosion or, put more broadly, "precursors" of installation ageing in older plants and sites (which extends beyond the case of pipe networks). Special attention must be paid to:
 - ✓ "corrosion sensitive points" (corrosion beneath thermal insulation, contact with supporting braces, etc.);
 - ✓ installations positioned in the vicinity of sensitive and vulnerable zones or located in an "aggressive" environment (tidal effects, medium salinity, etc.).
- Special attention must also be paid to monitoring and maintaining pipe networks in the plant by means of establishing pertinent criticality parameters (e.g. analysis of environmental risks related to a loss of structural integrity, sampling and control modes that enable early detection of corrosion or defects, periodicity of controls adapted to degradation kinetics, acceptability criteria specific to a defect).

Following this accident and based on results of inspections carried out on the Donges site pipes, a nationwide action was launched during 2008 focusing on probe controls of pipes carrying hydrocarbons. In 2009, a widespread plan centred on the ageing of industrial installations (petroleum, chemical) was initiated by France's Sustainable Development Ministry, which by the end of 2009 will yield a national action plan.

2/ Detection and protection measures:

The efficient control of certain specific operations (ship loading, pollutant transfer, etc.), especially on expansive sites, integrates appropriate resources to be allocated to leak detection and protection as well as vulnerability of the specific media.

3/ Means of intervention:

For those media in need, an action plan is developed that prescribes tools dedicated to impact evaluation, intervention and pollution cleanup, for mandatory implementation in case of an accident; the conditions governing the availability of such tools are also to be included.