Fire at a waste treatment plant covering nearly 18,000 m²

2 November 2013

Fos-sur-Mer (Bouches-du-Rhône) France

Fire
Waste
Difficult emergency response
Operating loss
Delayed detection
Malicious act

THE FACILITIES INVOLVED

The site:

The site is a multi-stream solid waste treatment facility located on an isolated, 18-ha parcel within the Fos-sur-Mer business park, a site devoted to industrial and port activities. This plant began operations in 2010 and employs a workforce of some 150 people. It receives approximately 1,100 tonnes of garbage and debris per day generated by the 18 municipalities making up the Marseille-Provence Metropolitan area, including Marseille, with rail being the primary mode of transport.

Operations of the site's 3 units are subjected to authorisation, as per legislation regarding classified facilities:

- an initial unit for receiving and conducting a primary sorting of residual household waste (RHW), offering a capacity of 440,000 tonnes/year. This type of waste is sorted into three main families: recyclable materials, organic waste, and combustibles. Upon completion of this sorting step, the various products are respectively: warehoused prior to being recycled into new materials, or routed to either organic or energy recovery units;
- an organic recovery unit (ORU), authorised to treat a total of 111,000 tonnes of raw organic waste per year. This unit is composed of two rotating fermentation tubes (RFT), a secondary sorter, plus an anaerobic digestion unit containing two digesters and a composting station;
- an energy recovery unit (ERU), authorised to handle 360,000 tonnes of combustible waste per year. This third unit comprises two parallel lines equipped with combustion heat recovery furnaces and boilers, plus a turbine generator for electricity production, a smoke filtration system and a clinker ageing platform.

Overview of the fire that broke out at the Fos-sur-Mer municipal solid waste treatment plant

The specific unit involved:

On the night of 2 November 2013, fire broke out in the organic recovery unit located inside the facility's secondary sorting building. This unit was idle at the time. The blaze then quickly spread to the composting zone and ultimately to the primary sorting and unloading sector.

The energy recovery unit only sustained very slight damage.

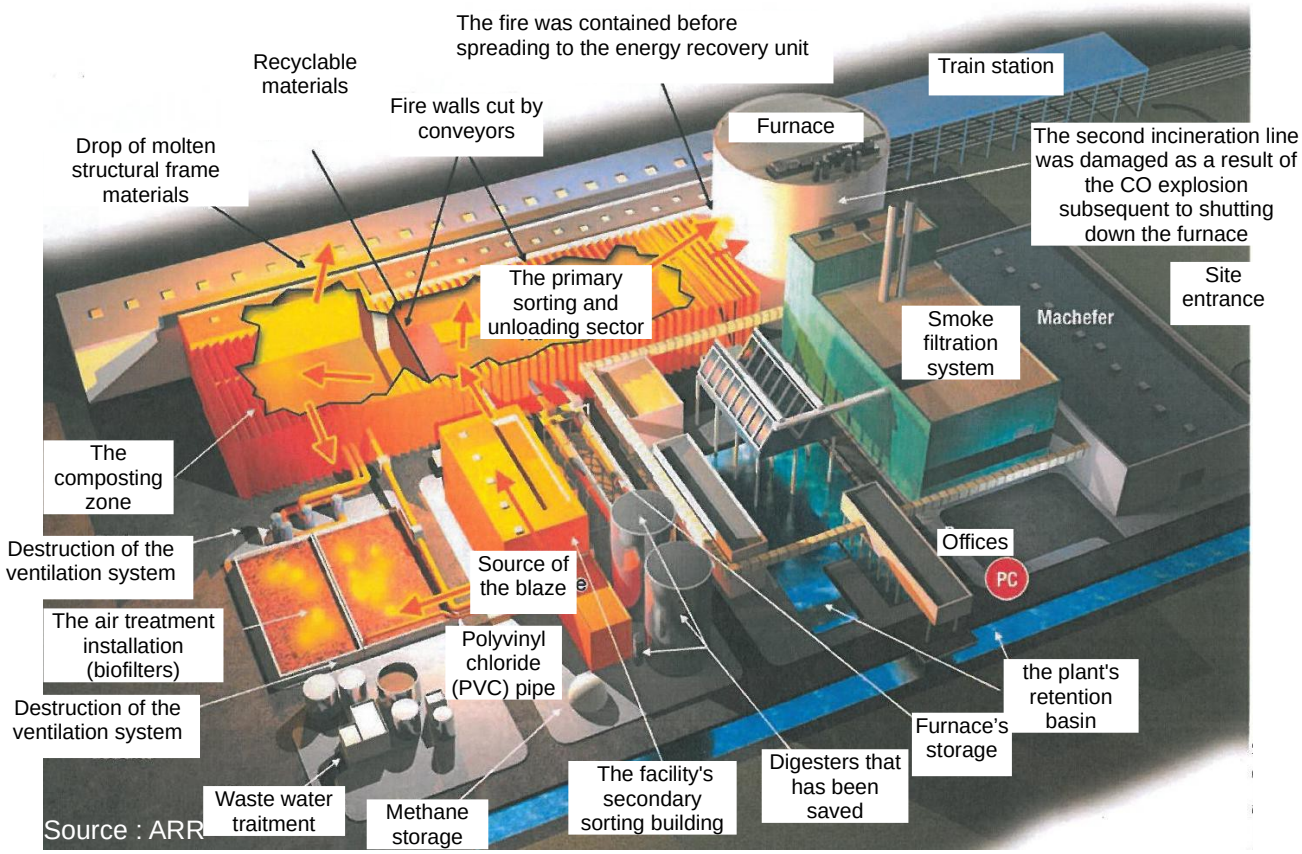

Diagram of how the fire spread inside the plant

THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

The accident:

At 2:38 am, the fire alarm in the electrical utility room of the secondary sorting building was tripped in the main control room.

At that same time, an employee located 100 m away in an adjacent building smelled smoke and discovered, in exiting that building, the 1,500-m^2 secondary sorting building in flames. He notified the site security office straight away.

First responders were immediately alerted by the control room of the energy recovery unit (ERU) .
Personnel of the ERU also showed up at the building and realised the infeasibility of an emergency response given the magnitude of the fire.

Informed of the situation around 2:45 am, the Director of Internal Operations (DIO) hurriedly arrived on-site and requested the internal emergency plan to be activated and mandatory protection deployed by fire-fighters for all installations within the biogas section of the plant, due to the risk of explosion.

Upon arriving at the scene around 3:05 am, external fire-fighters quickly attacked the blaze. Their response was initially intended to secure the most sensitive zones presenting either an explosion risk (i.e. anaerobic digesters, flexible biogas tanks) or a toxic risk (toxic product stockpiles including ammonia and methanol), in accordance with directives issued by the DIO.

Within just a few minutes, the flames fanned by a wind blowing from the south-south-east spread this outbreak to a 6,000-m^2 compost storage and ageing zone.

Primary sorting building ablaze

Incandescent cinders were suctioned by the fans, which were maintaining the buildings in a state of low pressure, causing the fire to spread to the air treatment and odour removal installations (biofilters laid out over 3,000 m²).

In less than an hour, the fire had engulfed the entire primary sorting zone. Then it advanced via conveyor belts crossing the fire walls as well as via the glued laminated timber frame atop these walls.
Fire-fighters took position to avoid the fire from spreading to the energy recovery unit.

Around 5:30 am, the sudden drop of molten structural frame materials from the primary sorting zone ignited two solid waste pits (covering a total of approx. 2,200 m^2 of surface area), thereby requiring fire-fighter intervention. The heart of the fire remained difficult to extinguish. After one attempt using water, fire-fighters launched an attack with foam.

Some 30 minutes later, a carbon monoxide explosion occurred on the lower part of one of the energy recovery unit furnaces, damaging the primary air intake duct. While remaining operable during the fire, this line had to be shut down when the control room was evacuated shortly after 3 am. The electricity cut-off stopped air inflow into the furnaces and combustion continued in an oxygen-depleted environment.

Given how the response was progressing, backup was requested. A major deployment of resources ensued: 140 emergency personnel and 40 vehicles battled the blaze under difficult conditions (due to the extent of protection required, coping with debris from partially collapsed structures, adverse weather conditions, a dense persistent smoke).

The fire extinction water was pumped into the plant's retention basin, whose operations were placed in a closed circuit in order to avoid effluent discharges outside the site boundary.

The fire was only brought under control in the evening. Smouldering outbreaks on the pits, the biofilter and the roof of the site's rail station were finally extinguished during the evening of 4 Nov. Two days later, the fire was officially considered totally extinguished. On-site monitoring was maintained through 8 Nov, i.e. 6 full days after the initial outbreak.

Consequences of this accident:

Human and social consequences

Despite the heavy quantity of smoke released, the facility's location was isolated from urbanised zones; moreover, with south-easterly winds sweeping the fallout of airborne particles towards the industrial park, the local population was not in any immediate danger.

As regards human impacts, no consequences were reported.

Environmental consequences

As of Saturday 2 November, the air quality regional agency's on-call manager announced that during the day, the concentrations of regulated pollutants in stations linked to the agency's network showed no differences from a typical day, and this finding held for all measured pollutants (nitrogen dioxide, sulphur dioxide, ozone and PM10 particulates).

An organisation specialised in managing emergency situations was contracted; samples of air, water (both groundwater and extinction water), soil and plants were conducted in the vicinity so as to determine whether the fire had caused an environmental impact (analytical parameters: PAH, phthalates, dioxins/furans, metals).
A marine environmental monitoring campaign was also undertaken.

Despite the lack of historical reference values for some parameters, the analyses performed did not reveal any **significant impact due to this fire on the environment**.

Physical and economic consequences

The waste unloading zone (for railcars) remained outside the fire perimeter, yet several beams running between the primary sorting/composting unit and the rail station were damaged by the fire. The station was reopened within the following weeks, subsequent to repair work and inspections. On-site waste deliveries partially resumed on 29 November 2013.

The down time of both pits 1 and 2, which were filled with drenched wastes during the fire-fighters' response, was initially estimated to last 4 months, corresponding to the period allocated to both repair the grabbing devices and evacuate leachates and wet waste to other treatment facilities.

To this day, the pits have been cleaned but remain unavailable for day-to-day operations. The damage sustained by the overhead track for grabbing devices (involving a misalignment problem) was in fact not detectable until a later time. The related works and inspections are scheduled for the upcoming months, and the pits should be placed back into service for day-to-day operations during the first part of 2015.

The primary and secondary sorting buildings as well as the composting platform were destroyed; these facilities accounted for over a third of all housed installations, for a total floor area around 18,000 m^2.


Source: SDIS - ARR


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The dismantling of the primary sorting building and the "composting" building has been completed, while the secondary sorting building has been nearly entirely dismantled, except for a few pieces of machinery awaiting expert appraisal as per the insurer's request. The site rebuilding project application was officially filed on 17 September 2014.

The two anaerobic digesters and the energy recovery unit were completely spared, except for the second incineration line (primary air intake duct on one of the two furnaces), which was damaged as a result of the CO explosion subsequent to shutting down the furnace 3 hours prior. This line regained its functionality, following repairs, as of 25 December 2013. The first incineration line had been restored on 25 November 2013, roughly twenty days after the fire.

Since December 2013, the site has been operating at nearly 90% of its handling capacity, with just the energy recovery unit. Two years of works are required for all damaged installations to resume operations.

Physical damage and production losses amount to several tens of millions of euros.

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 available information, this accident can be characterised by the four following indices:

Hazardous substances released	☐ ☐ ☐ ☐ ☐ ☐
Human and social consequences	☐ ☐ ☐ ☐ ☐ ☐
Environmental consequences	☐ ☐ ☐ ☐ ☐ ☐
Economic consequences	■ ■ ■ ■ ■ ☐

The parameters composing these indices and their rating methodology are available on the Web page: http://www.aria.developpement-durable.gouv.fr.

THE ORIGIN, CAUSES AND CIRCUMSTANCES OF THIS ACCIDENT

This fire broke out around the energy recovery unit, which is located in the "Secondary sorting" building dedicated to organic matter. This building was staffed by two 8-hour shifts.

Outside of working hours, i.e. at night after 9 pm, no personnel is assigned to the building, and all installations are emptied before the shift ends and cleaned of all organic matter. The building is thus free of any combustibles (organic matter), except for the structural components of the building itself (e.g. wall panels, conveyor belts).

During the preceding days, no maintenance work had been singled out as capable of causing a fire outbreak inside this building.

As for weather conditions, no thunderstorm activity had occurred within the zone. On the other hand, the presence of a south-south-easterly wind fanned and helped spread this blaze quickly.

In light of these on-site elements and resources (lack of video monitoring within the zone, failure on the part of the watchman or employees to observe any anomaly before 2:40 am), no physical cause responsible for the hot spot could be identified by the court-appointed expert.

In his report's conclusions, the insurance company expert excluded any accidental cause behind the ignition of this fire and moreover considered that the only plausible explanation was arson. The plant operator filed a complaint.

An analysis of how quickly the fire spread, however, revealed several issues mentioned during post-fire experience feedback:

- Despite the presence of some 200 smoke or flame detectors laid out across the buildings and electrical utility rooms, none was at the specific zone of the fire outbreak when it occurred. The absence of a means of detection in this building had been noted by the operator: the fact that this sector was assigned a permanent human presence during operations of the secondary sorting building led to the decision to merely install manual tripping devices, in recognising that at night, no activity is taking place inside the building and moreover the sorting line is systematically emptied and cleaned, thus leaving no combustible organic matter residue. Unfortunately, this absence of detection capability enabled the fire to generate momentum before being detected by a sensor located in one of the building's electrical utility rooms;
- Presence of many combustibles in the building materials (polycarbonate facade, wooden structural frames, rubber belt strips, etc.);
- Neutralised effect of the fire walls. As a matter of fact, some fire walls were cut by conveyors (with only some being equipped with water curtains), which were then covered by wooden structural members;
- Inability to turn off building ventilation despite the detection of fire. The incandescent particles suctioned into the air ducts connecting the various buildings spread this fire towards the air treatment facility (biofilters). The heat contained in these ducts then caused them to ignite;
- The smoke removal surface area and the compartmentalisation were deemed inadequate around the pits;
- Water availability needs to be optimised in the fire water supply basins, in spite of a sufficient water volume.

ACTIONS TAKEN

As regards post-accident management, a Prefectural emergency order was issued on 3 November 2013 by the regional Prefect, based on a proposal submitted by the Regional Directorate for the Environment, Development and Housing imposing that the operator implement all provisions to make it possible to conduct additional investigations to assess the accident's potential environmental impacts.

Start-up conditions were also established by way of an additional Prefectural decree, signed on 22 November 2013 and inspired from Classified Facilities inspectors' proposals.
As regards the energy recovery unit, which only sustained slight damage, the operator had to certify the unit's integrity and effective operations of all machinery therein, in addition to the various safety equipment, such as fire detection and protection networks (fire hose cabinet, hoses and water canons, etc.), prior to restart.

Given the emergency of the situation, inspection authorities granted the operator, as an exceptional measure, the right to incinerate residual municipal solid waste without any initial primary sorting. This degraded mode of operations was permitted while awaiting reconstruction of all site installations, in accordance with the Prefectural authorisation. It should be noted that nearly all of France's residual household waste incineration facilities operate without primary waste sorting. Yet a study was still requested within 3 months on the implementation of a temporary primary sorting solution either on-site or contracted to an off-site installation. At present, a temporary primary sorting station is being set up on-site.

In addition, to accommodate incoming waste, only one of the three pits is available to conduct ordinary operations, but this one had not been equipped to handle wastes received by train. While waiting for this system to come online, Classified Facilities inspectors issued a waiver allowing the operator to unload waste arriving by oversized lorries. This situation lasted 3 weeks and resulted in a temporary traffic of 15 lorries/day, for an incoming daily load of 325 tonnes of wastes.

The operator was asked to explain the conditions to adopt in order to manage the joint activity created by restarting the ERU and launching reconstruction works on the destroyed units.

A report verifying fire hydrant flow rates was also requested, so as to determine compliance with the Prefectural order. This verification exercise was conducted by a third-party.

For those installations treating gaseous effluents, a verification of the efficiency of filters used to treat smoke plus another verification of discharge monitoring device calibration had to be carried out. A higher frequency of inspections of airborne discharges by a third party was imposed upon the operator within the first 3 months following ERU restart.
The operator was also requested to specify conditions for managing odours (water, unloading building, pits) in addition to both rainwater and fire extinction water stored in the site's retention basins.

During the site reconstruction phase, the enhanced prevention and fire-fighting capacities, in terms of human, technical and organisational resources, were prescribed by another Prefectural order adopted in October 2014, consisting of:

- increasing the number of fire detectors in order to quickly notify the operator of any fire outbreak, including around the conveyor belts and air suction ducts running between the buildings;
- servo-controlling the conveyor belt shutdown to the fire detection system;
- installing cut-off valves on the air suction ducts between buildings, whereby the closing mechanism is servo-controlled to the fire detection system;
- ensuring the permanent presence of a backup response team equipped with Self-Breathing Apparatus;
- adding a mixed 2,000 l/min water/foam cannon with a hitch for towing and two 1,000-litre tanks of emulsifier;
- setting up additional fire water outlets in the reserve water supply, and improving the re-supply of these facilities (electric generating set / booster pump);
- doubling the number of water cannons installed around waste pit no. 3 as well as the number of smoke removal hatches located above the three pits;
- pressurising the control and instrumentation room in order to permanently maintain it free of smoke in the event the pit ignites;
- updating the internal emergency plan and proceeding with its test in conjunction with the local Fire Services.

The operator also added extra security at the installation access points beginning on 8 September 2014, by means of creating new "safety agent" positions. With this new organisational set-up, the site has an around-the-clock presence with two employees assigned these enhanced security functions (one from the hired security firm, the other a designated security agent).

The density of cameras mounted has also been raised and another line of protection added to the plant's fence around sensitive zones, such as the railway section of the site or the watchman's station.

Given the previous elements, no criminal charges were brought or administrative injunctions issued by Classified Facilities inspectors.

LESSONS LEARNT

The main lessons that can be drawn from this type of fire within a municipal solid waste treatment plant are as follows:

- ✔ The importance of fire detection with a relay to the control room, in zones where the particular wastes are present, but also near the conveyors and suction ducts, in order to respond as quickly as possible;
- ✔ Reactivity required, accident knowledge, deployment of an emergency response;
- ✔ The preliminary study proves vital to establishing construction provisions for a building and avoiding and/or limiting all the ways a fire can spread: fire walls exceeding roof height, institution of compensatory measures in the event these walls are crossed by conveyor-type equipment so as to ensure continuity in the degree of fire protection, choice of non-combustible construction materials, placement of fire cut-off valves within the air extraction ducts;
- ✔ The importance of the right design for fire-fighting resources, whether they are human, technical or organisational;
- ✔ Mandatory monitoring of both the industrial site and its access points, in the aim of preventing acts of malicious intent;

- ✔ Site location within a sparsely-populated sector in order to both limit the population's exposure to risks and enhance the proximity of local emergency services to speed on-site response times;

- ✔ Identification of the installation's specific hazard zones that are to be protected as a priority to avoid generating a secondary accident: identification of both explosion-risk and toxicity-risk zones;

- ✔ Knowledge of the risks associated with these specific hazard zones;

- ✔ Personnel evacuation in a situation of degraded operations under rapid conditions;

- ✔ Introduction of post-accident management procedures, on one hand to analyse pollutant concentrations (PAH, phthalates, PCB, dioxins/furans, metals) in the various surrounding natural media (water / air / soil and plants), and on the other hand to evaluate the potential impacts of these pollutants in their media, coupled with the appropriate remedial measures to be adopted.