

Explosion av bensinångor (VCE) på en lageranläggning för flytande kolväten.

911007 MARS 1800_35

Strax efter klockan 04:00 varnades två anställda på ett kontor av en förare som kom från parkeringsplatsen att det luktade bensin över hela parkeringsplatsen. Inget anmärkningsvärt hade noterats av nattvakt eller andra förare tidigare under natten. De två anställda satte sig i en bil (!) för att undersöka om det kunde vara så att där fanns ett moln av bensinångor på drift. Klockan 04:20 upptäckte de ett vitaktigt moln som drev mot parkeringsplatsen och vidare mot vägen på andra sidan. Molnet bestod då av en bensinaerosol på 25 000 m³ som täckte hela parkeringsplatsen. En gnista från en lastbil på parkeringsplatsen antände ångmolnet. Intensiteten på explosionen har uppskattats till motsvarande 1800-3600 kg TNT. Stötvågen kastade de två anställda i diket, men de kunde återvända till kontrollrummet, stänga alla ventiler och slå larm. Räddningstjänsten anlände klockan 04:38. Den interna katastrofplanen sattes i verket och lagerområdet utrymdes. Kylning av intilliggande tankar med vattengardiner sattes igång. Polisen stängde av trafiken på järnväg och väg kring området. Klockan 04:50 antändes flera tankar och branden bekämpades med skumkanoner. Branden bekämpades av nära 200 personer. Branden var släckt klockan 12:17.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
blyfri bensin i den inledande explosionen		1000-6000 kg
blyfri bensin i branden		3600 ton
bränsleolja		1000 ton
kolväten som spreds med släckningsvattnet		ca 500 m ³

Skador:

Människor:	Två människor på lagerområdet och tre utanför (på parkeringsplatsen) skadades av explosionen.
Materiella:	Byggnader på lagerområdet skadades påtagligt medan byggnader och fordon utanför lagerområdet skadades av nedfall. Explosionen slet loss tak 300 m bort och krossade fönsterrutor på 700 m avstånd.
Miljö/ekologi:	Förorening av mark och vatten begränsades till själva lagerområdet. Höga koncentrationer av kolväten kunde konstateras i längre tid efter olyckan.
Infrastruktur:	Järnvägs- och biltrafik i närområdet stängdes av av polisen.

Erfarenheter redovisade (Ja/Nej): Ja

Mycket kort redogörs för några förebyggande åtgärder.

Report Profile

Identification of Report:

country: FA ident key: 1800_035_01

reported under Seveso I directive as major accident reports: SHORT+FULL

Date of Major Occurrence: Time of Major Occurrence

start: 1991-10-07 start: 04:00:00

finish: finish:

Establishment:

name:

address:

industry: 2008 wholesale and retail storage and distribution (incl. LPG bottling & bulk

distrib., more: F1!)

Liquid Hydrocarbons Storage Plant

Seveso II status: not applicable: Yes **art. 6 (notification):** No

art. 7 (MAPP): No

art. 9 (safety report): No

Date of Report:

short: full:

Authority Reporting:

name:

address:

Authority Contact:

rep_cont_name:

rep_cont_phone:

rep_cont_fax:

Additional Comments:

a) - not applicable -

b) - not applicable -

c) - not applicable -

d) - not applicable -

e) - not applicable -

Short Report

country: FA **ident key:** 1800_035_01

Accident Types:

release: Yes **explosion:** Yes

water contamination: Yes **other:** No

fire: Yes

description:

SYSTEM ORIGINATING AND OPERATING CONDITIONS:... see Appendix Short Report / description of accident types

Substance(s) Directly Involved:

toxic: No **explosive:** Yes

ecotoxic: No **other:** No

flammable: Yes

description:

- Unleaded Petrol: amount involved in the unconfined vapour cloud explosion = 1,000*6,000 Kg depending on

calculation hypotheses.... see Appendix Short Report / description of substances involved

Immediate Sources of Accident:

storage: Yes **transfer:** No

process: No **other:** No

description:

The accident occurred during normal operation in a storage plant for liquid hydrocarbons. The storage plant was located in an industrial area with no houses in the proximity, as shown on Annex N° 4 attached to the Original Report.

Suspected Causes:

plant or equipment: No **environmental:** No

human: No **other:** Yes

description:

CAUSES:... see Appendix Short Report / description of suspected causes

Immediate Effects:

material loss: Yes

human deaths: No

human injuries: Yes **community disruption:** Yes

other: No

ecological harm: Yes

national heritage loss: No

description:

EFFECTS ON PEOPLE:... see Appendix Short Report / description of immediate effects

Emergency Measures taken:

on-site systems: Yes **decontamination:** No

external services: Yes **restoration:** Yes

sheltering: No **other:** No

evacuation: Yes

description:

INTERNAL TO THE ESTABLISHMENT:... see Appendix Short Report / description of emergency measures taken

Immediate Lessons Learned:

prevention: Yes **other:** No

mitigation: Yes

description:

MEASURES TO MITIGATE THE EFFECTS OF THE ACCIDENT:... see Appendix Short Report / description of immediate lessons learned

A Occurrence Full Report

country: FA **ident key:** 1800_035_01

1 Type of Accident

remarks: Due to the leakage of unleaded petrol (code 1102), about 25,000 m3 of aerosol formed. The unconfined cloud explosion was then ignited by a lorry, parked but with motor running, resulting in a vapor cloud explosion (code

1307). The explosion... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The total establishment and the potential directly involved inventories of unleaded petrol and fuel oil refer to the amounts involved in the accident.

About unleaded petrol, about 1,000*6,000 Kg (depending on calculation hypotheses) were in... see Appendix Full Report A / dangerous substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred during normal operation in a storage plant for liquid hydrocarbons (codes 3202 and 2008). The components involved were the tanks for the storage of unleaded petrol and gasoil (code 4003). The storage plant was located ... see Appendix Full Report A / source of accident - remarks

4 Meteorological Conditions

precipitation none: fog: rain: hail: snow:

Yes No No No No

wind speed (m/s):

direction (from):

stability (Pasquill):

ambient temperature (°C):

remarks: Wind favourable. No rain.

5 Causes of Major Occurrence

main causes

technical / physical 5501 other: not identified

- not applicable -

- not applicable -

- not applicable -

- not applicable -

human / organizational - not applicable -

- not applicable -

- not applicable -

- not applicable -

- not applicable -

remarks: A leakage of unleaded petrol formed aerosol (estimated volume about 25,000 m3) that was ignited by a lorry, parked but with motor running. When the Original Report was prepared the causes of the leakage were still under investigation (code... see Appendix Full Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA ident key: 1800_035_01

event:

major occurrence 1307 explosion: VCE (vapour cloud explosion; supersonic wave front)

initiating event - not applicable -

associated event - not applicable -

event:

major occurrence 1202 fire: pool fire (burning pool of liquid, contained or uncontained)

initiating event 1102 release: fluid release to ground

associated event 1404 other: firewater runoff into ground

Dangerous substances

country: FA **ident key:** 1800_035_01

a) total establishment inventory

CAS number: **identity:** Unleaded Petrol

name from Seveso I Directive: - not applicable -

name from Seveso II Directive: - not applicable -

category from Seveso II: - not applicable -

other hazards (1): - not applicable -

other hazards (2): - not applicable -

maximum quantity (tonnes): 3600

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 3600 **potential quantity:** 3600

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 **indir_pot_quant:** -1

a) total establishment inventory

CAS number: **identity:** Fuel Oil

name from Seveso I Directive: - not applicable -

name from Seveso II Directive: - not applicable -

category from Seveso II: - not applicable -

other hazards (1): - not applicable -

other hazards (2): - not applicable -

maximum quantity (tonnes): 3800

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 1000 **potential quantity:** 3800

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 **indir_pot_quant:** -1

Source of Accident - Situation **country:** FA **ident key:** 1800_035_01

situation

industry

initiating event 2008 wholesale and retail storage and distribution (incl. LPG bottling & bulk distrib., more: F1!)

associated event 2008 wholesale and retail storage and distribution (incl. LPG bottling & bulk distrib., more: F1!)

activity/unit

major occurrence 3202 storage: distribution-associated (not on-site of manufacture)

initiating event 3202 storage: distribution-associated (not on-site of manufacture)

associated event 3202 storage: distribution-associated (not on-site of manufacture)

component

major occurrence 4003 container; non-pressurised (hopper, tank, drum, bag, etc.)

initiating event 4003 container; non-pressurised (hopper, tank, drum, bag, etc.)

associated event 4003 container; non-pressurised (hopper, tank, drum, bag, etc.)

B Consequences Full Report

country: FA **ident key:** 1800_035_01

1 Area concerned

affected

extent of effects installation: Yes

establishment: Yes

off-site; local: No

off-site; regional: No

off-site; transboundary: No

illustration of effects - not applicable -

remarks The pollution of the soil and of the underground water was limited to the area o... see Appendix

Full Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk 215

immediate fatalities

subsequent fatalities

hospitalizing injuries 2 3

other serious injuries

health monitoring

remarks 2 people inside the establishment and 3 outside it (in the parking area) were in... see Appendix

Full Report B / people

3 Ecological Harm

pollution/contamination/damage of:

- residential area (covered by toxic cloud) Suspected

- **common wild flora/fauna (death or elimination)** Suspected
- **rare or protected flora/fauna (death or elimination)** Suspected
- **water catchment areas and supplies for consumption or recreation** not applicable
- **land (with known potential for long term ecological harm or preventing human access or activities)** Suspected
- **marine or fresh water habitat** Suspected
- **areas of high conservation value or given special protection** Suspected

remarks The pollution of the soil and of the underground water was limited to the area o... see Appendix

Full Report B / ecological harm

4 National Heritage Loss

effects on:

- **historical sites** not applicable - **historic monuments** not applicable
- **historic buildings** not applicable - **art treasures** not applicable

remarks No data available.

5 Material Loss

establishment losses off site losses

costs (direct costs to operator) (social costs)

in ECU ECU

material losses

response, clean up, restoration

remarks Inside the establishment, the explosion and the subsequent fire caused the total... see Appendix

Full Report B / material loss

6 Disruption of Community Life

establishment/plant evacuated disabled/unoccupiable destroyed

- **nearby residences/hotels** No No No
- **nearby factories/offices/small shops** No No No
- **schools, hospitals, institutions** No No No
- **other places of public assembly** No No No

interruption of utilities etc. no / yes duration

- **gas** No
- **electricity** No
- **water** No
- **sewage treatment works** No
- **telecommunications** No
- **main roads** No
- **railways** No
- **waterways** No
- **air transport** No

significant public concern none local level national level

- off site populations No Yes No

- media interest No No No

- political interest No No No

remarks The road and rail traffic was interrupted by the police.... see Appendix Full Report B / disrupti

7 Discussion of Consequences

Ecological Components involved

country: FA ident key: 1800_035_01

type: 6201 freshwater: freshwater reservoir

threatened: not applicable affected: not applicable

C Response Full Report

country: FA ident key: 1800_035_01

1 Emergency Measures

taken - on site - not applicable - - not applicable -

- not applicable - - not applicable -

- not applicable - - not applicable -

- off site - not applicable - - not applicable -

- not applicable - - not applicable -

- not applicable - - not applicable -

still - on site - not applicable - - not applicable -

required

- not applicable - - not applicable -

- not applicable - - not applicable -

- off site - not applicable - - not applicable -

- not applicable - - not applicable -

- not applicable - - not applicable -

continuing contamination or danger

-on site not applicable

-off site not applicable

remarks - not applicable -

2 Seveso II Duties

pre-accident evaluation

Article item not due yet not done done/submitted evaluated

6 notification No No No No

7 policy (MAPP) No No No No

9 safety report No No No No

9, 10, 11 update No No No No

11 internal plan No No No No

11 external plan No No No No

13 informing public No No No No

9, 12 siting policy No No No No

post-accident evaluation

Seveso II duty was actual were actual compared with actual

contingency consequences consequences, the

addressed? addressed? predicted extent was?

Article item

7 policy (MAPP) not applicable not applicable not applicable

9 current safety report not applicable not applicable not applicable

11 internal plan not applicable not applicable not applicable

11 external plan not applicable not applicable not applicable

13 informing public not applicable not applicable not applicable

9, 12 siting policy not applicable not applicable not applicable

evaluation of safety organisation

organisational element element existed did element relate to actual circumstances of

yes / no no / partly / yes adequate?

- written policy objectives No

- specified management No

structure

- specified responsibilities No

- specified working procedures No

- specified procedures for No

assessment/auditing of

management system

- specified procedures for No

review and update of

management policy

- specified general training No

procedures

- specified emergency No

training procedures

evaluation of ecological impact control

organisational element element existed did element relate to actual circumstances of

yes / no no / partly / yes adequate?

- ecological status review No

before incident

- potential ecological No

consequences assessment

- **ecological impact review** No

after incident

- **ecological restoration** No

procedures

- **subsequent review of** No

restoration success

remarks - not applicable -

3 Official Action Taken

legal action

- not applicable -

other official action

- not applicable -

4 Lessons Learned

measures to prevent recurrence

MEASURES TO PREVENT ANY RECURR... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

MEASURES TO MITIGATE THE EFFEC... see Appendix Full Report C / lesson learned - mitigate

useful references:

On the basis of the damages ca... see Appendix Full Report C / lesson learned - references

5 Discussion about Response

- not applicable -

Appendices for the FA / 1800_035_01 report

Appendix Short Report / description of accident types:

SYSTEM ORIGINATING AND OPERATING CONDITIONS:

Storage facility in normal operation.

ENVIRONMENTAL AND ATMOSPHERICAL CONDITIONS:

Wind favourable. No rain.

SAFETY SYSTEMS OR OPERATORS INTERVENTION:

The operators came back to the control room to stop via electric remote control the bottom valves of the tanks.

ACCIDENT CASE HISTORY DESCRIPTION:

The night guardian and drivers did not notice anything unusual at 02:50 am, 03:05 am, 03:25 am and 03:50 am. The night guardian passed a check-point behind storage tank N° 31 at 04:00 am and did not notice anything abnormal. At 04:00 am 2 employees arrived in the office company (it is situated about 250 m from the parking lot for lorries). A few minutes after their arrival 5 valves on the tanks' bottom were activated including tanks N° 30 and 31. At 04:10, a driver from the parking lot passed by the office to warn about a petrol smelling mist on the parking place. The two employees check this phenomenon (moving around in car!) first at the parking place and then inside the establishment. At 04:20 the 2 men observed a mist whiter than fog at the east counterfort of the tank N° 22 and inside the retention basin of tanks N° 30 and 31. None of the other retention basins contained any mist. The mist entered the parking lot passing under the counterfort separating the retention basin from the parking lot. The mist covered the whole parking area and was just about reaching the road. At 04:20 am a violent explosion happened originating from the parking place and propagating towards the storage area. The two employees were thrown in the retention basin by the shock wave, but managed to return to the office and close the automatic valves. The emergency services arrived on-site at 04:38 am. The police blocked the access to the roads around the storage facility, and the railway traffic was interrupted. The tanks caught fire at 04:50 am. The fire was extinguished at 12.17. A more detailed accident case history description is shown on Annex N° 1 attached to the Original Report.

Appendix Short Report / description of substances involved:

- Unleaded Petrol: amount involved in the unconfined vapour cloud explosion = 1,000[^]6,000 Kg depending on calculation hypotheses.

- Unleaded Petrol: amount involved in the fire = 3,600,000 Kg.

- Fuel Oil: amount involved in the fire = 3,800,000 Kg of which 1,000,000 Kg were burned.

- Hydrocarbons contained in the fire water infiltrated in the soil of the storage area: amount involved = about 500 m3 of Unleaded Petrol over a 20,000 m2 surface.

Appendix Short Report / description of suspected causes:

CAUSES:

A leakage (source unknown) of unleaded petrol formed aerosol (estimated volume about 25,000 m³) that was ignited by a lorry, parked but with motor running. When the Original Report was prepared the causes of the leakage were still under investigation, as shown on Annex N° 3 attached to the Original Report.

Appendix Short Report / description of immediate effects:

EFFECTS ON PEOPLE:

2 people inside the establishment and 3 outside it (in the parking area) were injured by the explosion.

MATERIAL LOSS:

Inside the establishment the explosion and the subsequent fire caused the total or partial destruction of 5 storage tanks, 15 road tankers, operation/control rooms, lorries' washing station. Outside the establishment, the debris damaged hangars, vehicles and nearby buildings. The overpressure generated by the explosion damaged panel-roofs up to 300 m and windows were broken up to 700m. On the basis of the damages caused by the explosion it has been estimated that the amount of equivalent TNT involved was about 1,800³6,600 Kg as shown on Annex N° 6 attached to the Original Report.

ECOLOGICAL HARM:

The pollution of the soil and of the underground water was limited to the area of the industrial site. When the Original Report was prepared, there were still some high concentrations of hydrocarbons in the ground and in the water-bearing stratum (see Annex N° 5 attached to the Original Report).

COMMUNITY DISRUPTION:

The road and rail traffic was interrupted by the police.

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

The two employees, even thrown in the retention basin by the shock wave generated by the explosion, managed to return to the office and close the automatic valves of the tanks. The Internal Emergency Plan was activated and the personnel was evacuated. The water curtains on tanks N° 20 and 21 were activated. The tank containing propane was cooled.

EXTERNAL TO THE ESTABLISHMENT

Together with fire brigade from the Loire-Atlantique department, arrived on-site: fire brigade from DONGES refinery, three ships from NANTES-SAINT NAZARE harbour, fire brigades from nearby departments of Vendee, Ile-et-Vilaine, Maine-et-Loire, Finistere. 195 firemen (plus 20 radio operators) were involved in the fire fighting operations. About 51,300 litres of foam (on the 80,800 litres available) and 15 monitors (that means a flow of 21,600 l/minute of foam and 6,400 l/minute of water for cooling and firemen protection) were used as shown on Annex N° 2 attached to the Original Report. Local authorities were alerted. The Regional Hospital Center and the Emergency Medical Service were activated. The road and rail traffic was interrupted by the police.

Appendix Short Report / description of immediate lessons learned:

MEASURES TO MITIGATE THE EFFECTS OF THE ACCIDENT:

A sampling campaign and measurements of the gas on the ground allowed to evaluate exactly the pollution of the water-bearing stratum and to choose a suitable depollution technique (soilventing) as shown on Annex N° 5 attached to the Original Report.

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

Before restarting the operation of this facility, a new request of authorization must be submitted. This request should contain a safety report in which the experience made in this accident (causes and consequences) will be taken into account, on the basis of the results of the investigations.

Appendix Full Report A / type of accident:

Due to the leakage of unleaded petrol (code 1102), about 25,000 m³ of aerosol formed. The unconfined cloud explosion was then ignited by a lorry, parked but with motor running, resulting in a vapor cloud explosion (code 1307). The explosion was then followed by a fire (code 1202) and the fire water user in extinguishing operations, containing hydrocarbons, infiltrated and polluted the soil (about 20,000 m² surface) of the storage area (code 1404).

Appendix Full Report A / dangerous substances:

The total establishment and the potential directly involved inventories of unleaded petrol and fuel oil refer to the amounts involved in the accident. About unleaded petrol, about 1,000³6,000 Kg (depending on calculation hypotheses) were involved in the unconfined vapour cloud explosion whilst 3,600,000 Kg in the subsequent fire. About 500 m³ of unleaded petrol infiltrated in the soil with the fire water. About 1,000,000 Kg (over 3,800,000 Kg available) of fuel oil were burned.

Appendix Full Report A / source of accident - remarks:

The accident occurred during normal operation in a storage plant for liquid hydrocarbons (codes 3202 and 2008). The components involved were the tanks for the storage of unleaded petrol and gasoil (code 4003). The storage plant was located in an industrial area with no houses in the proximity, as shown on Annex N° 4 attached to the Original Report.

Appendix Full Report A / causes of major occurrence:

A leakage of unleaded petrol formed aerosol (estimated volume about 25,000 m³) that was ignited by a lorry, parked but with motor running. When the Original Report was prepared the causes of the leakage were still under investigation (code 5501), as shown on Annex N° 3 attached to the Original Report.

Appendix Full Report B / area concerned - remarks:

The pollution of the soil and of the underground water was limited to the area of the industrial site. When the Original Report was prepared, there were still some high concentrations of hydrocarbons in the ground and in the water-bearing stratum (see Annex N° 5 attached to the Original Report). The explosion of the unconfined vapour cloud caused damages outside the establishment.

Appendix Full Report B / people:

2 people inside the establishment and 3 outside it (in the parking area) were injured by the explosion. 195 firemen (plus 20 radio operators) were involved in the fire fighting operations.

Appendix Full Report B / ecological harm:

The pollution of the soil and of the underground water was limited to the area of the industrial site. When the Original Report was prepared, there were still some high concentrations of hydrocarbons in the ground and in the water-bearing stratum (see Annex N° 5 attached to the Original Report).

Appendix Full Report B / material loss:

Inside the establishment, the explosion and the subsequent fire caused the total or partial destruction of 5 storage tanks, 15 road tankers, operation/control rooms, lorries' washing station. Outside the establishment, the debris damaged hangars, vehicles and nearby buildings. The overpressure generated by the explosion damaged panel-roofs up to 300 m and windows were broken up to 700m. No data are available about the cost of the material damages.

Appendix Full Report B / disruption of community life:

The road and rail traffic was interrupted by the police.

Appendix Full Report C / lesson learned - prevent:

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

Before restarting the operation of this facility, a new request of authorization must be submitted. This request should contain a safety report in which the experience made in this accident (causes and consequences) will be taken into account, on the basis of the results of the investigations.

Appendix Full Report C / lesson learned - mitigate:

MEASURES TO MITIGATE THE EFFECTS OF THE ACCIDENT:

A sampling campaign and measurements of the gas on the ground allowed to evaluate exactly the pollution of the water-bearing stratum and to choose a suitable depollution technique (soilventing) as shown on Annex N° 5 attached to the Original Report.

Appendix Full Report C / lesson learned - references:

On the basis of the damages caused by the unconfined vapour cloud explosion, it has been estimated that the amount of equivalent TNT involved was about 1,800'3,600 Kg as shown on Annex N° 6 attached to the Original Report.