

Explosion och brand på en bränsledepå.

870515 MARS 1987_07

Olyckan inträffade på en bränsledepå under rutinmässig avgasning av en tank som innehållit metanol. Avgasning skedde utan inertkväve och utan föregående kontroll av gashalter i tanken. Fem arbetare befann sig på tanken då en luft-metanol ånga antändes och tanken exploderade. Fyra av arbetarna omkom och den femte skadades svårt och fick föras till sjukhus. Explosionen följdes av ytterligare två då två intilliggande tankar också exploderade. En fjärde tank slogs upp och läckte hexan. Räddningstjänsten tillkallades och bekämpade branden.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
metanol (explosion)	67-56-1	okänt
metanol (brand)	67-56-1	5400 m3
nonan	111-84-2	okänt
hexan	110-54-3	okänt
xylén	1330-20-7	okänt

Skador:

Människor:	4 människor omkom och en skadades av den första explosionen.
Materiella:	Anläggningen skadades påtagligt. Utanför området krossades fönster på närliggande bostadshus.
Miljö/ekologi:	Inga effekter rapporterade.
Infrastruktur:	De närliggande bostadshusen evakuerades. Järnvägs- och biltrafik spärrades av i närheten av olycksplatsen.

Erfarenheter redovisade (Ja/Nej): Ja

Kortfattat anges förebyggande åtgärder.

Report Profile

Identification of Report:

country: FA ident key: 1987_007_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1987-05-15 start: 08:00:00

finish: finish:

Establishment:

name:

address:

industry: 2002 petrochemical, refining, processing

Storage of Petrochemical Products

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:** 1987_007_01

Accident Types:

release: No **explosion:** Yes

water contamination: No **other:** No

fire: Yes

description:

ACCIDENT CASE HISTORY DESCRIPTION:... see Appendix Short Report / description of accident types

Substance(s) Directly Involved:

toxic: Yes **explosive:** Yes

ecotoxic: No **other:** No

flammable: Yes

description:

- Methanol (C.A.S. CODE: 67-56-1, E.E.C. CODE: 603-001-00-X): amount involved in the explosion = not known...

see Appendix Short Report / description of substances involved

Immediate Sources of Accident:

storage: Yes **transfer:** No

process: No **other:** No

description:

The accident occurred in a coastal petrochemical storage installation. The installation was 20 metres far from

the rail-way Milano-Ventimiglia and close to a school and other residential buildings. In the storage plant

there were atmospheri... see Appendix Short Report / description of immediate sources

Suspected Causes:

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

human: Yes **other:** No

description:

INITIATING EVENT AND CONSEQUENCES:... see Appendix Short Report / description of suspected causes

Immediate Effects:

material loss: Yes

human deaths: Yes

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:** No

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 PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:... see Appendix Short Report / description of immediate lessons learned

A Occurrence Full Report

country: FA **ident key:** 1987_007_01

1 Type of Accident

remarks: During degassing operations of an empty storage tank with air, the residual methanol vapours/air mixture formed was ignited, resulting in a confined vapour explosion (code 1307). It caused the explosions in other two nearby storage tanks (c... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The total establishment and the potential directly involved inventories of methanol refer to the whole operating useful capacity of tanks N^o 44 and 45 (about 5,400 m³). No data are available about the amount of the methanol vapours inside t... see Appendix Full Report A / dangerous substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred in a coastal petrochemical storage installation (codes 2002 and 3202) and involved 4 atmospheric tanks (code 4003). Tank N⁻ 42 contained, in three separate sections, nonane, hexane and xylene. Tank N⁻ 43 had previously... see Appendix Full Report A / source of accident - remarks

4 Meteorological Conditions

precipitation none: fog: rain: hail: snow:

No No No No No

wind speed (m/s):

direction (from):

stability (Pasquill):

ambient temperature (°C):

remarks: - not applicable -

5 Causes of Major Occurrence

main causes

technical / physical - not applicable -

- not applicable -

- not applicable -

- not applicable -

- not applicable -

human / organizational 5301 organization: management organization inadequate

5303 organization: organized procedures (none, inadequate, inappropriate, unclear)

5304 organization: training/instruction (none, inadequate, inappropriate)

5307 organization: process analysis (inadequate, incorrect)

5308 organization: design of plant/equipment/system (inadequate, inappropriate)

remarks: The ignition of an explosive methanol vapours/air occurred inside an empty tank likely during degassing operations (the tank was degassed with air in order to recover nonane because it was supposed to be incompatible with methanol). The ope... see Appendix Full Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA ident key: 1987_007_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 1307 explosion: VCE (vapour cloud explosion; supersonic wave front)

associated event - not applicable -

Dangerous substances

country: FA ident key: 1987_007_01

a) total establishment inventory

CAS number: 1330-20-7 identity: Xylene

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): -1

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: -1 potential quantity: -1

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: 111-84-2 identity: Nonane

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): -1

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: -1 potential quantity: -1

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: 67-56-1 identity: Methanol

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): 2137

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: -1 potential quantity: 2317

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: 110-54-3 identity: Hexane

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): -1

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: -1 potential quantity: -1

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

Source of Accident - Situation country: FA ident key: 1987_007_01

situation

industry

initiating event 2002 petrochemical, refining, processing

associated event - not applicable -

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 - not applicable -

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 - not applicable -

B Consequences Full Report

country: FA ident key: 1987_007_01

1 Area concerned

affected

extent of effects installation: Yes

establishment: Yes

off-site; local: Yes

off-site; regional: No

off-site; transboundary: No

illustration of effects - not applicable -

remarks The explosion and the following fire caused the destruction of: storage tanks, p... see Appendix

Full Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk 15

immediate fatalities 4

subsequent fatalities

hospitalizing injuries 1

other serious injuries

health monitoring

remarks `When the accident occurred, in the coastal depot were operating 15 people: 4 of... 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)** not applicable

- **rare or protected flora/fauna (death or elimination)** Suspected

- **water catchment areas and supplies for consumption or recreation** Suspected

- **land (with known potential for long term ecological harm or** Suspected

preventing human access or activities)

- **marine or fresh water habitat** Suspected

- **areas of high conservation value or given special protection** Suspected

remarks In the Original Report there is no evidence of significant ecological harms exce... 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 The explosion and the following fire caused the destruction of: storage tanks, p... 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 No Yes

- **media interest** No No No

- **political interest** No No No

remarks The nearby houses were evacuated. The rail-way Milano-Ventimiglia and the road t... see Appendix

7 Discussion of Consequences

C Response Full Report

country: FA **ident key:** 1987_007_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

When the Original Report was p... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

Locating plants at a safe dist... see Appendix Full Report C / lesson learned - mitigate

useful references:

- not applicable -

5 Discussion about Response

- not applicable -

Appendices for the FA / 1987_007_01 report

Appendix Short Report / description of accident types:

ACCIDENT CASE HISTORY DESCRIPTION:

Taking also into account witnesses who heard a first big explosion and a few seconds later two other more suffocated explosions, it was deduced that most likely the empty

tank N° 43 exploded first causing the explosions of tanks N° 44 and 45. The explosions of tanks N° 44 and 45 were followed by the fire of the contained methanol. Tank N° 42 was also partially damaged because of the explosion of the adjacent N° 43: it was still emitting hexane vapours during the inspection. Probably the explosion was caused by the ignition of a mixture of residual methanol vapours with air formed during the degassing operations of tank N° 43 (it was degassed with air in order to recover nonane). When the explosion occurred, five workers were working on degassing operations: after the accident, three dead bodies had been recovered and another worker was missed (his lifeless body was found a few days later). On the basis of the positions in which their bodies were found, they were presumably on top of the tank N° 43, near to an open man-hole. The last worker, heavily injured, had been found in the pump-room and was hospitalized. According to Carmagnani's officials the tank's cleaning was considered a routine operation: depending on the substances to remove, water or air were used for cleaning purposes. In case of purging with water, washing water gathered by a draining system was conveyed to a waste-water treatment plant. In case that two incompatible substances had to be loaded subsequently into the same tank, purging with air was used (air was pumped in the vessel through a man-hole and was discharged from other openings). This situation occurred for tank N° 43 because methanol residues were considered incompatible with nonane that had to be stored. All purging operations were normally carried out without neither nitrogen protection nor by monitoring the surrounding environment for the presence of flammable gases. No fixed explosimeter or smoke detectors were installed but the operators could make use of portable explosimeters and personal protection devices (breathing apparatuses, filters, masks). The first aid room was equipped with stretchers and medical supplies and fire extinguishers were placed as laid down under the Fire Brigade's Regulations.

Appendix Short Report / description of substances involved:

- Methanol (C.A.S. CODE: 67-56-1, E.E.C. CODE: 603-001-00-X): amount involved in the explosion = not known.

- Methanol (C.A.S. CODE: 67-56-1, E.E.C. CODE: 603-001-00-X): amount involved in the fire = 2,137,050 Kg (about 5,400 m³, the whole operating capacity of the tanks N° 44 and 45 damaged by the explosion in tank N° 43).

- Nonane (C.A.S. CODE: 111-84-2): amount involved = not known.

- Hexane (C.A.S. CODE: 110-54-3): amount involved = not known.

- Xylene (C.A.S. CODE: 1330-20-7): amount involved = not known.

Appendix Short Report / description of immediate sources:

The accident occurred in a coastal petrochemical storage installation. The installation was 20 metres far from the rail-way Milano-Ventimiglia and close to a school and other residential buildings. In the storage plant there were atmospheric tanks of two kinds:

a) tanks N° 42 and 43, with a parallelepipedal shape, slightly less in capacity than the others and made in steel plate with reinforcing ribs on every side with the roof held up by metal trusses;

b) tanks N° 44 and 45 (with a volumetric capacity of 3,000 m³ and an operating useful capacity of 2,700 m³ each) that were built more recently, with a carrying structure in reinforced concrete and internally lined to improve their tightness with steel sheeting. Both roof and supporting pillars were also in reinforced concrete lined with steel sheet.

All tanks were covered by an earth layer (about 1m thick) and equipped on the roof with vents and man-holes. Tank N° 42 contained, in three separate sections, nonane, hexane and xylene. Tank N° 43 had previously contained methanol but, when the accident occurred, was practically empty and had to be decontaminated to receive subsequently nonane. Tanks N° 44 and 45 were filled with pure methanol.

The whole number of workers of the depot was 84, operating in two or, exceptionally, three shifts. When the accident occurred, in the depot were operating 15 people.

Appendix Short Report / description of suspected causes:

INITIATING EVENT AND CONSEQUENCES:

The ignition of an explosive methanol vapours/air mixture occurred inside an empty tank likely during degassing operations (the tank was degassed with air in order to recover nonane).

CAUSES:

The ignition of an explosive methanol vapours/air occurred inside an empty tank likely during degassing operations (the tank was degassed with air in order to recover nonane because it was supposed to be incompatible with methanol). The operation was carried out without neither nitrogen protection nor by monitoring the presence of flammable gases. No fixed explosimeter or smoke detectors were installed but the operators could make use of portable explosimeters and personal protection devices (breathing apparatuses, filters, masks).

Appendix Short Report / description of immediate effects:

EFFECTS ON PEOPLE:

4 people were killed and 1 injured by the explosion in tank N° 43. All of them were working in the coastal depot. No one outside the installation was injured.

MATERIAL LOSS:

The explosion and the following fire caused the destruction of: storage tanks, pipelines, window panes, doors and factory fence.

Outside the installation the explosion caused the breakage of the windows and a slight deformation of the doors of the nearby buildings. No data are available about the cost of the damages.

ECOLOGICAL HARM:

Some trees burned only in the close area around the installation.

COMMUNITY DISRUPTION:

The nearby houses were evacuated. The rail-way Milano-Ventimiglia and the road traffic were halted.

MAP OF THE ACCIDENT AREA AND MAX. DENSITY OF POPULATION:

The installation was 20 metres far from the rail-way Milano-Ventimiglia and close to a school and other residential buildings.

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

The fire brigade intervened using suitable foam. When the Original Report was prepared methanol was maintained under foam until the temperature became low enough to allow its pouring-off in safe conditions.

EXTERNAL TO THE ESTABLISHMENT:

The nearby houses were evacuated. The rail-way Milano-Ventimiglia and the road traffic were halted.

Appendix Short Report / description of immediate lessons learned:

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

When the Original Report was prepared the situation was under examination by the competent authorities. It is believed preventive measures will also be taken for similar installations, which may include:

- 1- the improvement of the internal safety organization;
- 2- the installation of sensors for monitor the concentration of dangerous substances in the air, connected with alarm systems;
- 3- setting up of work-permit procedures;
- 4- the use of well-trained personnel.

MEASURES TO MITIGATE THE EFFECTS OF THE ACCIDENT:

- 1- locating plants at a safe distance from other activities.

Appendix Full Report A / type of accident:

During degassing operations of an empty storage tank with air, the residual methanol vapours/air mixture formed was ignited, resulting in a confined vapour explosion (code 1307). It caused the explosions in other two nearby storage tanks (code 1307) and the contained methanol caught fire (code 1202). A third tank was damaged by the explosion, resulting in a hexane vapours release but the effects of the leakage were non significant.

Appendix Full Report A / dangerous substances:

The total establishment and the potential directly involved inventories of methanol refer to the whole operating useful capacity of tanks N° 44 and 45 (about 5,400 m3). No data are available about the amount of the methanol vapours inside the tank N° 43 where the explosion occurred. Tank N° 42 contained, in three separate sections, nonane, hexane and xylene but no data are available about its volumetric capacity.

Appendix Full Report A / source of accident - remarks:

The accident occurred in a coastal petrochemical storage installation (codes 2002 and 3202) and involved 4 atmospheric tanks (code 4003). Tank N° 42 contained, in three separate sections, nonane, hexane and xylene. Tank N° 43 had previously contained methanol but, when the accident occurred, was practically empty. Tanks N° 44 and 45 were filled with pure methanol. The installation was 20 metres far from the rail-way Milano-Ventimiglia and close to a school and other residential buildings.

Appendix Full Report A / causes of major occurrence:

The ignition of an explosive methanol vapours/air occurred inside an empty tank likely during degassing operations (the tank was degassed with air in order to recover nonane because it was supposed to be incompatible with methanol). The operation was carried out without neither nitrogen protection nor by monitoring the presence of flammable gases (codes 5301, 5303 and 5304). No fixed explosimeter or smoke detectors were installed (code 5307 and 5308).

Appendix Full Report B / area concerned - remarks:

The explosion and the following fire caused the destruction of: storage tanks, pipelines, window panes, doors and factory fence. Outside the installation the explosion caused the breakage of the windows and a slight deformation of the doors of the nearby buildings. Some trees burned but only in the close area around the installation. The nearby houses were evacuated. The rail-way Milano-Ventimiglia and the road traffic were halted.

Appendix Full Report B / people:

When the accident occurred, in the coastal depot were operating 15 people: 4 of them were killed and 1 injured by the explosion in tank N° 43. Outside the installation were exposed: the students and the personnel of the school 20 metres far from the factory fence and 40 metres from tank N° 43; people which were travelling on Milano-Ventimiglia rail-way 20 metres far from tank N° 43; people living in the nearby buildings. None of them was injured by the accident.

Appendix Full Report B / ecological harm:

In the Original Report there is no evidence of significant ecological harms except some trees burned only in the close area around the installation. It is not fully clear if trees were natural or planted.

Appendix Full Report B / material loss:

The explosion and the following fire caused the destruction of: storage tanks, pipelines, window panes, doors and factory fence. Outside the installation the explosion caused the breakage of the windows and a slight deformation of the doors of the nearby buildings. No data are available about the cost of the damages.

Appendix Full Report B / disruption of community life:

The nearby houses were evacuated. The rail-way Milano-Ventimiglia and the road traffic were halted.

Appendix Full Report C / lesson learned - prevent:

When the Original Report was prepared the situation was under examination by the competent authorities. It is believed preventive measures will also be taken for similar installations, which may include:

- 1- the improvement of the internal safety organization;
- 2- the installation of sensors for monitor the concentration of dangerous substances in the air, connected with alarm systems;

3- setting up of work-permit procedures;

4- the use of well-trained personnel.

Appendix Full Report C / lesson learned - mitigate:

Locating plants at a safe distance from other activities.