

Gasexplosion och brand på en petrokemisk fabrik.

850118 MARS 1985_01

Olyckan inträffade under rutinmässig drift på en destillationsanläggning för etylen. Utomhustemperaturen var -10°C . En isplugg i en rörledning förorsakade ett utsläpp av propylen. Den utsläppta propylen bildade ett gasmoln som antändes 4 minuter senare. Gasexplosionen ledde till en omfattande brand. Fönster krossades av stötvågen. Larm gick och produktionen i området stoppades. Räddningstjänsten anlände med 124 man och 46 brandbilar. Branden var släckt inom en och en halv timme.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
etylen	74-85-1	
propylen	115-07-1	
sammanlagt explosion:		4,1 ton
sammanlagt brand:		flera hundra ton

Skador:

Människor:	43 människor skadades, 7 så allvarligt att de fick föras till sjukhus.
Materiella:	Allvarliga skador på byggnader på fabriksområdet. Fönster krossades så långt bort som 9 km.
Miljö/ekologi:	Inga effekter rapporterade.
Infrastruktur:	Inga.

Erfarenheter redovisade (Ja/Nej): Ja

Kortfattat anges förebyggande åtgärder.

Report Profile

Identification of Report:

country: FA ident key: 1985_001_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1985-01-18 start: 16:00:00

finish: finish:

Establishment:

name:

address:

industry: 2002 petrochemical, refining, processing

Petrochemical (Ethylene Production 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:** 1985_001_01

Accident Types:

release: Yes **explosion:** Yes

water contamination: No **other:** No

fire: Yes

description:

SAFETY SYSTEMS OR OPERATORS INTERVENTION:... see Appendix Short Report / description of accident types

Substance(s) Directly Involved:

toxic: No **explosive:** Yes

ecotoxic: No **other:** No

flammable: Yes

description:

- Ethylene (C.A.S. CODE: 74-85-1, E.E.C. CODE: 601-010-00-3) and Propylene (C.A.S. CODE: 115-07-1): amount

involved in the unconfined gas cloud explosion = 4.1 tonnes.... see Appendix Short Report / description of

substances involved

Immediate Sources of Accident:

storage: No **transfer:** No

process: Yes **other:** No

description:

The accident occurred during normal operation in a distillation unit of the Ethylene Production Plant in a

petrochemical industry.

Suspected Causes:

plant or equipment: Yes **environmental:** Yes

human: No **other:** No

description:

INITIATING EVENT AND CONSEQUENCES:... 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: No

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: Yes **other:** No

evacuation: No

description:

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

Immediate Lessons Learned:

prevention: Yes **other:** No

mitigation: Yes

description:

EXTERNAL TO THE ESTABLISHMENT:... see Appendix Short Report / description of immediate lessons learned

A Occurrence Full Report

country: FA **ident key:** 1985_001_01

1 Type of Accident

remarks: The piping of an unused by-pass failed because of unforeseen ice formation

in it as a result of water accumulation and low ambient temperature (-10°C).

The released propylene (code 1101) created a gas cloud that was ignited 4

minutes later,... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: No precise data are available about the amount of ethylene and propylene

involved in the accident. In the Original Report an amount of 4.1 tonnes of

ethylene and propylene involved in the accident is shown whilst, about their

amount involve... see Appendix Full Report A / dangerous substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred during normal operation in a distillation unit of the

Ethylene Production Plant (code 3102) in a petrochemical industry (code

2002). The component involved in the propylene release was the piping of an unused by-pass (... 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): -10

remarks: High atmospheric pressure. Dead calm. Ambient temperature = -10°C.

5 Causes of Major Occurrence

main causes

technical / physical 5102 operation: component/machinery failure/malfunction

5201 environment: natural event (weather, temperature, earthquake, etc.)

- not applicable -

- not applicable -

- not applicable -

human / organizational 5307 organization: process analysis (inadequate, incorrect)

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

- not applicable -

- not applicable -

- not applicable -

remarks: The failure of the piping (code 5102) was caused by the unexpected presence of humidity.

It resulted in the pipeline failure due to ice formation caused by an ambient temperature

below zero (-10°C) in the point where the water had been accu... see Appendix Full Report

A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA **ident key:** 1985_001_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 1101 release: gas/vapour/mist/etc release to air

associated event - not applicable -

Dangerous substances

country: FA ident key: 1985_001_01

a) total establishment inventory

CAS number: 115-07-1 identity: Propylene

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: 74-85-1 identity: Ethylene

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: 1985_001_01

situation

industry

initiating event - not applicable -

associated event - not applicable -

activity/unit

major occurrence - not applicable -

initiating event - not applicable -

associated event - not applicable -

component

major occurrence 4011 general pipework/flanges

initiating event - not applicable -

associated event - not applicable -

situation

industry

initiating event 2002 petrochemical, refining, processing

associated event - not applicable -

activity/unit

major occurrence 3102 process: chemical continuous reaction

initiating event 3102 process: chemical continuous reaction

associated event - not applicable -

component

major occurrence 4007 machinery/equipment (pump, filter, column separator, mixer, etc.)

initiating event 4011 general pipework/flanges

associated event - not applicable -

B Consequences Full Report

country: FA **ident key:** 1985_001_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 Due to the overpressure, only insignificant damages to the main structures of th... see Appendix

Full Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk

immediate fatalities

subsequent fatalities

hospitalizing injuries 7

other serious injuries 36

health monitoring

remarks Inside the establishment 43 people were injured (7 of them were hospitalized) by... 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 Suspected
- 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 In the Original Report there is no evidence of significant ecological harms.... 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 DM ECU DM

material losses 1,75E+08

response, clean up, restoration

remarks The accident caused serious material damages both inside (estimated in about 150... 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 Window panes outside the establishment broke as far as 9 Km. The population was ... see Appendix

7 Discussion of Consequences

C Response Full Report

country: FA ident key: 1985_001_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

After the accident, it has been... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

After the accident the followi... see Appendix Full Report C / lesson learned - mitigate

useful references:

- not applicable -

5 Discussion about Response

- not applicable -

Appendices for the FA / 1985_001_01 report

Appendix Short Report / description of accident types:

SAFETY SYSTEMS OR OPERATORS INTERVENTION:

The released gas was detected by the plant personnel and also signaled by gas detectors. The plant was shut-down.

ENVIRONMENTAL AND ATMOSPHERIC CONDITIONS:

High atmospheric pressure. Dead calm. Ambient temperature = -10°C .

ACCIDENT CASE HISTORY DESCRIPTION:

The piping of an unused by-pass failed because of unforeseen ice formation in it as a result of water accumulation and low ambient temperature (-10°C). The released propylene created a gas cloud that was ignited 4 minutes later, causing an unconfined gas cloud explosion and a large fire. The overpressure generated by the deflagration caused the breakage of numerous window panes inside the establishment. Damages to the buildings occurred but the main structures did not present any significant damage. Distillation columns located in the process area were strongly damaged by the fire. A distillation column (9m high) was broken and crashed with other nearby columns. The substances contained in vessels and pipelines were released resulting in a large fire that, one and a half hour later, was under control. The fire was extinguished on January 27, at 01:00 a.m. Inside the establishment 43 people were injured and 7 people were hospitalized. Due to the overpressure, only insignificant damages to the main structures of the buildings occurred within 200m (near to the explosion point the main structures resisted without damages) and limited damages to buildings (external and internal walls) within 400m, while 80% of normal window panes broke close to the point of explosion, 50% of these at distances between 200 and 400m away, and up to 20% at distances between 400m and 1,000m away. Window panes outside the establishment broke as far as 9 Km.

Appendix Short Report / description of substances involved:

- Ethylene (C.A.S. CODE: 74-85-1, E.E.C. CODE: 601-010-00-3) and Propylene (C.A.S. CODE: 115-07-1): amount involved in the unconfined gas cloud explosion = 4.1 tonnes.

- Ethylene (C.A.S. CODE: 74-85-1, E.E.C. CODE: 601-010-00-3) and Propylene (C.A.S. CODE: 115-07-1): amount involved in the fire = several hundreds tonnes.

Appendix Short Report / description of suspected causes:

INITIATING EVENT AND CONSEQUENCES:

Failure of a piping of an unused by-pass because of unforeseen ice formation in it as a result of water accumulation and low ambient temperature (-10°C).

CAUSES:

The failure of the piping was caused by the unexpected presence of humidity in the production flow previously dried. It resulted in the pipeline failure due to ice formation caused by an ambient temperature below zero (-10°C) in the point where the water had been accumulated.

Appendix Short Report / description of immediate effects:

EFFECTS ON PEOPLE:

Inside the establishment 43 people were injured (7 of them were hospitalized) by the explosion of the unconfined gas cloud.

MATERIAL LOSS:

The accident caused serious material damages both inside (estimated in about 150-200 millions of Deutch Marcs [about 75-96 MECU]) and outside the establishment. Due to the overpressure, only insignificant damages to the main structures of the buildings occurred within 200m (near to the explosion point the main structures resisted without damages) and limited damages to buildings (external and internal walls) within 400m, while 80% of normal window panes broke close to the point of explosion, 50% of these at distances between 200 and 400m away, and up to 20% at distances between 400m and 1,000m away. Window panes outside the establishment broke as far as 9 Km.

COMMUNITY DISRUPTION:

Window panes outside the establishment broke as far as 9 Km.

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

The internal alarm was sounded and the production in the potentially hazardous area was halted. Intervention of 124 firemen with 46 fire trucks to rescue the personnel of the establishment.

EXTERNAL TO THE ESTABLISHMENT:

The population was alerted about the accident and help was given to the surrounding population. The Authority organized a worker's team to repair the damaged windows and roofs to allow people to live in their houses.

Appendix Short Report / description of immediate lessons learned:

EXTERNAL TO THE ESTABLISHMENT:

The Authority organized a worker's team to repair the damaged windows and roofs to allow people to live in their houses.

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

After the accident, it has been established that, where residual humidity could not be excluded, the accumulation and freezing of water must be avoided by suitable construction measures (e.g. suitable piping lay-out or external heating). Manual draining according to procedures did not present an acceptable alternative.

MEASURES TO MITIGATE THE EFFECTS OF THE ACCIDENT:

After the accident the following measures were established:

- 1- reliable rapid-isolation valves to be installed at various points to allow the isolation of the various sections (they must be properly marked for quick identification);
- 2- the suitability of building and structure design criteria as well as of safety window glass has been revealed. Improvements are needed in some areas, especially for those parts of the construction that do not carry loads (such as the materials and fittings of the facade walls, type of roof lining and associated fittings, avoiding the use of glass as a constructional element);
- 3- the smooth performance of the rescue and fire fighting services revealed the value of the existing emergency plan in reducing the extent of the damages.

Appendix Full Report A / type of accident:

The piping of an unused by-pass failed because of unforeseen ice formation in it as a result of water accumulation and low ambient temperature (-10°C). The released propylene (code 1101) created a gas cloud that was ignited 4 minutes later, causing an unconfined gas cloud explosion (code 1307) and a large fire (code 1202).

Appendix Full Report A / dangerous substances:

No precise data are available about the amount of ethylene and propylene involved in the accident. In the Original Report an amount of 4.1 tonnes of ethylene and propylene involved in the accident is shown whilst, about their amount involved in the fire, a generic information of several hundreds tonnes is reported.

Appendix Full Report A / source of accident - remarks:

The accident occurred during normal operation in a distillation unit of the Ethylene Production Plant (code 3102) in a petrochemical industry (code 2002). The component involved in the propylene release was the piping of an unused by-pass (code 4011) whilst the components involved in the fire were pipelines (code 4011) and distillation columns (code 4007).

Appendix Full Report A / causes of major occurrence:

The failure of the piping (code 5102) was caused by the unexpected presence of humidity. It resulted in the pipeline failure due to ice formation caused by an ambient temperature below zero (-10°C) in the point where the water had been accumulated (code 5201). The presence of humidity in that piping was unexpected because of a process analysis and a plant design inadequate (codes 5307 and 5308) [manual draining according to procedures were not an acceptable alternative].

Appendix Full Report B / area concerned - remarks:

Due to the overpressure, only insignificant damages to the main structures of the buildings occurred within 200m (near to the explosion point the main structures resisted without damages) and limited damages to buildings (external and internal walls) within 400m. Window panes outside the establishment broke as far as 9 Km.

Appendix Full Report B / people:

Inside the establishment 43 people were injured (7 of them were hospitalized) by the explosion of the unconfined gas cloud.

Appendix Full Report B / ecological harm:

In the Original Report there is no evidence of significant ecological harms.

Appendix Full Report B / material loss:

The accident caused serious material damages both inside (estimated in about 150*200 millions of Deutch Marcs [about 75*96 MECU]) and outside the establishment. Due to the overpressure, only insignificant damages to the main structures of the buildings occurred within 200m (near to the explosion point the main structures resisted without damages) and limited damages to buildings (external and internal walls) within 400m.

Appendix Full Report B / disruption of community life:

Window panes outside the establishment broke as far as 9 Km. The population was alerted about the accident and help was given to the surrounding population.

Appendix Full Report C / lesson learned - prevent:

After the accident, it has been established that, where residual humidity could not be excluded, the accumulation and freezing of water must be avoided by suitable construction measures (e.g. suitable piping lay-out or external heating). Manual draining according to procedures did not present an acceptable alternative.

Appendix Full Report C / lesson learned - mitigate:

After the accident the following measures were established:

- 1- reliable rapid-isolation valves to be installed at various points to allow the isolation of the various sections (they must be properly marked for quick identification);
- 2- the suitability of building and structure design criteria as well as of safety window glass has been revealed. Improvements are needed in some areas, especially for those parts of the construction that do not carry loads (such as the materials and fittings of the facade walls, type of roof lining and associated fittings, avoiding the use of glass as a constructional element);
- 3- the smooth performance of the rescue and fire fighting services revealed the value of the existing emergency plan in reducing the extent of the damages.

The Authority organized a worker's team to repair the damaged windows and roofs to allow people to live in their houses.