Gasutsläpp och brand på en polyetylenfabrik i petrokemisk industri.

880407 MARS 1988_18

Under uppstart efter underhållsarbete på en kompressorenhetuppstod en oväntad tryckstegring. Kompressorn fortsatte att gå trots att den stängdes av. Vid tryckstegringen brast ett sprängbleck vid lägre tryck än avsett och den gas som släpptes ut fattade eld i en explosion. Larmet gick och företagets interna brandkår släckte elden.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
etylen	74-85-1	500 kg

Skador:

Människor:	Inga.
Materiella:	Anläggningen skadades.
Miljö/ekologi:	Inga effekter rapporterade.
Infrastruktur:	Inga.

Erfarenheter redovisade (Ja/Nej): Ja

Mycket kortfattat anges förebyggande åtgärder.

Report Profile

Identification of Report:

country: FA **ident key:** 1988_018_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1988-04-07 **start:** 09:00:00

finish: finish:

Establishment:

name:

address:

industry: 2002 petrochemical, refining, processing

Petrochemical (Polymer and Chemicals Production)

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:** 1988_018_01

Accident Types:

release: Yes **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: 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): amount involved = about 500 Kg.

Immediate Sources of Accident:

storage: No **transfer:** No

process: Yes **other:** No

description:

The accident occurred during the start-up procedure after maintenance of the two stage compressor unit at the feeding section of a polyethylene plant of a petrochemical industry. The factory was located in an industrial area. Living areas w... see Appendix Short Report / description of immediate sources

Suspected Causes:

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

human: No **other:** No

description:

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

Immediate Effects:

material loss: Yes

human deaths: No

human injuries: No **community disruption:** No

other: No

ecological harm: No

national heritage loss: No

description:

MATERIAL LOSS:... see Appendix Short Report / description of immediate effects

Emergency Measures taken:

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

external services: No **restoration:** No

sheltering: No **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: No

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:** 1988_018_01

1 Type of Accident

remarks: During the start-up procedure after maintenance of the two stage compressor unit at the feeding section of a polyethylene plant, a bursting disc located at the first compressor discharge burst due to pressure build-up. As the disc discharge... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The total establishment and the potential directly involved inventories of ethylene refer to the amount involved in the release and, subsequently, in the unconfined vapour cloud explosion and flash-fire.

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred during the start-up procedure after maintenance of the two stage compressor unit at the feeding section of a polyethylene plant (code 3102) of a petrochemical industry (2002). The component involved was the bursting di... 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 5102 operation: component/machinery failure/malfunction

5105 operation: instrument/control/monitoring-device failure

- not applicable -

- not applicable -

- not applicable -

human / organizational 5308 organization: design of plant/equipment/system (inadequate,

inappropriate)

5314 organization: testing/inspecting/recording (none, inadequate,

inappropriate)

- not applicable -

- not applicable -

- not applicable -

remarks: The causes of the accident were: failure of the primary compressor to shut-down when

manually stopped (code 5102); failure of the high-pressure switch to operate at 279 bar

(code 5105), due also to an insufficient testing procedure (code 53... see Appendix Full

Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident **country:** FA **ident key:** 1988_018_01

event:

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

initiating event 1301 explosion: pressure burst (rupture of pressure system)

associated event - not applicable -

event:

major occurrence 1203 fire: jet flame (burning jet of fluid from orifice)

initiating event 1101 release: gas/vapour/mist/etc release to air

associated event - not applicable -

Dangerous substances

country: FA **ident key:** 1988_018_01

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): 0,5

use of substance as: STARTING MATERIAL

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 0,5 **potential quantity:** 0,5

c) substance belongs to relevant inventory indirectly involved: No

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

Source of Accident - Situation **country:** FA **ident key:** 1988_018_01

situation

industry

inititating event - not applicable -

associated event - not applicable -

activity/unit

major occurrence - not applicable -

inititating event - not applicable -

associated event - not applicable -

component

major occurrence 4011 general pipework/flanges

inititating event 4011 general pipework/flanges

associated event - not applicable -

situation

industry

inititating event 2002 petrochemical, refining, processing

associated event - not applicable -

activity/unit

major occurrence 3102 process: chemical continuous reaction

inititating event 3102 process: chemical continuous reaction

associated event - not applicable -

component

major occurrence 4008 power source (engine, compressor, etc.)

inititating event 4008 power source (engine, compressor, etc.)

associated event - not applicable -

B Consequences Full Report

country: FA **ident key:** 1988_018_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 In the Original Report there is no evidence of significant effects outside the e... 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

other serious injuries

health monitoring

remarks No data are available about the number of people involved in the accident.... 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 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.... 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 HFL ECU HFL

material losses 100000

response, clean up, restoration

remarks The cost of the structural damages to the plant caused by the explosion and the ... 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 Yes No No

- media interest No No No

- political interest No No No

remarks In the Original Report there is no evidence of significant effects outside the e... see Appendix

7 Discussion of Consequences

C Response Full Report

country: FA **ident key:** 1988_018_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, the follow... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

- not applicable -

useful references:

- not applicable -

5 Discussion about Response

- not applicable -

Appendices for the FA / 1988_018_01 report

Appendix Short Report / description of accident types:

ACCIDENT CASE HISTORY DESCRIPTION:

During the start-up procedure after maintenance of the two stage compressor unit at the feeding section of a polyethylene plant, the pressure at the primary compressor discharge reached a value of 310 bar. Owing to pressure build-up, a bursting disc, located at the primary compressor discharge, burst at a somewhat lower pressure than expected (possibily owing to fatigue). As the bursting disc discharge piping had not been designed for the resulting dynamic pressure, it was torn from the collector release line. The released gas ignited, resulting in an explosion followed by a fire.

The causes (a sketch of the system affected is also included in the original report) that led to the accident were:

- the alarm signal was activated at approximately 265 bar and the primary compressor was stopped manually (about 300 bar);

- the high-pressure switch at primary compressor discharge, which was supposed to cut off the primary compressor at 279 bar, failed;

- the safety valve at primary compressor discharge worked as designed and opened gradually (between 297 and 328 bar) increasing its capacity with the pressure, but the full capacity was reached too slowly;

- the bursting disc at primary compressor discharge bursted at somewhat lower pressure than expected (possibly owing to fatigue);

- the bursting disc discharge piping had not been designed for the resulting dynamic pressure and was torn from the collector release line.

Appendix Short Report / description of immediate sources:

The accident occurred during the start-up procedure after maintenance of the two stage compressor unit at the feeding section of a polyethylene plant of a petrochemical industry. The factory was located in an industrial area. Living areas were several hundreds of metres from the factory (no population in proximity of the process plant). The component involved was the bursting disc discharge piping installed at the first compressor discharge. The pressure at the first compressor discharge reached a value of 310 bar. Ethylene (at 2,400 bar) was then fed into a tube reactor to produce polyethylene. A sketch of the compressors unit together with the instrumentation and the safety devices is attached to the Original Report.

Appendix Short Report / description of suspected causes:

CAUSES:

The causes of the accident were:

- failure of the primary compressor to shut-down when manually stopped;

- failure of the high-pressure switch to operate at 279 bar;

- failure of the pressure safety valve to reach the full capacity in a short time;

- failure of the bursting disc discharge piping to withstand to the resulting dynamic pressure the disc burst.

The underlying causes were an inadequate design plant and an insufficient testing procedures of the high-pressure switch.

Appendix Short Report / description of immediate effects:

MATERIAL LOSS:

The cost of the structural damages to the plant caused by the explosion and the fire has been estimated in about 100,000 Guilders (about 40,000 ECU). The production losses has been estimated in several millions of Guilders (several millions of ECU).

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

The emergency shut-down of the entire system was activated and the fire alarm was sounded. The company fire brigade intervened and cooled the unit by means of fixed extinguishing installations.

Appendix Short Report / description of immediate lessons learned:

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

After the accident, the following measures were established:

1- redimensioning of the pressure safety valve and discharge lines of the safety devices;

2- improved testing about the performance of the high-pressure switch;

3- practical tests of a new design using nitrogen.

Appendix Full Report A / type of accident:

During the start-up procedure after maintenance of the two stage compressor unit at the feeding section of a polyethylene plant, a bursting disc located at the first compressor discharge burst due to pressure build-up. As the disc discharge piping was not designed for the resulting dynamic pressure, it was torn from the collector release line (code 1301) and an ethylene release occurred (code 1101). The released gas ignited resulting in an explosion (code 1307) followed by a fire (code 1203).

Appendix Full Report A / source of accident - remarks:

The accident occurred during the start-up procedure after maintenance of the two stage compressor unit at the feeding section of a polyethylene plant (code 3102) of a petrochemical industry (2002). The component involved was the bursting disc discharge piping (code 4008) installed at the first compressor discharge (code 4011). The factory was located in an industrial area. Living areas were several hundreds of metres from the factory (no population in proximity of the process plant).

Appendix Full Report A / causes of major occurrence:

The causes of the accident were: failure of the primary compressor to shut-down when manually stopped (code 5102); failure of the high-pressure switch to operate at 279 bar (code 5105), due also to an insufficient testing procedure (code 5314); failure of the pressure safety valve to reach full capacity in a short time and of the bursting disc discharge piping to withstand to the resulting dynamic pressure, both due to an inadequate design (code 5308).

Appendix Full Report B / area concerned - remarks:

In the Original Report there is no evidence of significant effects outside the establishment.

Appendix Full Report B / people:

No data are available about the number of people involved in the accident.

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 cost of the structural damages to the plant caused by the explosion and the fire has been estimated in about 100,000 Guilders (about 40,000 ECU). The production losses has been estimated in several millions of Guilders (several millions of ECU).

Appendix Full Report B / disruption of community life:

In the Original Report there is no evidence of significant effects outside the establishment.

Appendix Full Report C / lesson learned - prevent:

After the accident, the following measures were established:

1- redimensioning of the pressure safety valve and discharge lines of the safety devices;

2- improved testing about the performance of the high-pressure switch;

3- practical tests of a new design using nitrogen.