Explosion och brand på en petrokemisk anläggning.

891017 MARS 1989_17

Olyckan inträffade vid underhållsarbete på en tank. Då ett provtagningsmunstycke till en tank öppnades för att förhindra okontrollerad förlust av ångor från tanken antändes den utströmmande ångan (09:38). En och en halv meter bort användes en elektrisk såg för att skära i aluminium. Gnistor antände acrylonitrilångorna och tankens innehåll fattade eld. Räddningstjänsten anropades och företagets katastrofplan trädde i verket. Räddningstjänsten var på plats mycket kort tid efter anrop. Efter 50 minuter påbörjade evakuering av 250 personer från angränsande företag. Efter tre timmar (12:45) gjordes ett första försök att släcka branden. Efter tio minuter var branden släckt, men återantändes inom en minut. Efter ytterligare 50 minuter (13:48) var branden slutgiltigt släckt.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
explosionen		
acrylonitril (ångor)	107-13-1	500 kg
branden		
acrylonitril	107-13-1	200 ton

Skador:

Människor:	Tre personer omkom, och två skadades vid explosionen.
Materiella:	Inga.
Miljö/ekologi:	Inga effekter rapporterade.
Infrastruktur:	Närliggande företag utrymdes. Ca 250 personer berördes.

Erfarenheter redovisade (Ja/Nej): Ja

Mycket kortfattat anges förebyggande åtgärder.

Report Profile

Identification of Report:

country: FA **ident key:** 1989_017_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1989-10-17 **start:** 09:35:00

finish: finish:

Establishment:

name:

address:

industry: 2004 pesticides, pharmaceuticals, other fine chemicals

Petrochemical (Loading, Unloading and Storage of Various Chemicals)

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:** 1989_017_01

Accident Types:

release: No **explosion:** Yes

water contamination: No **other:** No

fire: Yes

description:

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

Substance(s) Directly Involved:

toxic: Yes **explosive:** Yes

ecotoxic: No **other:** No

flammable: Yes

description:

- Acrylonitrile (C.A.S. CODE: 107-13-1): amount involved during the explosion = 500 kg of vapours.... 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 the removal of insulation from tanks for scheduled maintenance in a storage area

of a petrochemical industry for loading, unloading and storage of various chemicals. The lay-out of the

storage area is shown on A... 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:** No

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: 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:

When the Original Report was prepared, the judicial investigation was still in progress. The question of guilt

is: Is storage of acrylonitrile without nitrogen-blanketing permitted ? In the Netherlands, inhibitor is the

decisive factor.... see Appendix Short Report / description of immediate lessons learned

A Occurrence Full Report

country: FA **ident key:** 1989_017_01

1 Type of Accident

remarks: During the removal of insulation from all K1-tanks for scheduled maintenance

a tank sampling nozzle was opened to prevent uncontrolled escape of

vapours. At 1.5 metre from the nozzle, an electrical saw was used to cut the

aluminium sheet co... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The total establishment and the potential directly involved inventorie of

acrylonitrile refer to the contents of tank N¯ 823 where the explosion

occurred. About 500 Kg of acrylonitrile were involved in the explosion; the

residual amoun in t... see Appendix Full Report A / dangerous substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred during the removal of insulation from tanks (code 4003) for scheduled maintenance in a storage area (code 3201) of a petrochemical industry (code 2002) for loading, unloading and storage of various chemicals. The lay-o... 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): 210¯ˆ250¯

stability (Pasquill):

ambient temperature (∞C):

remarks: Wind direction 210¯, turning to 250¯, as shown in Annex III attached to the Original Report.

5 Causes of Major Occurrence

main causes

technical / physical - not applicable -

- not applicable -

- not applicable -

- not applicable -

- not applicable -

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

5401 person: operator error

- not applicable -

- not applicable -

- not applicable -

remarks: During the removal of insulation from tank N¯ 823 a tank sampling nozzle was opened to prevent uncontrolled escape of vapours. At 1.5 metre from the nozzle, an electrical saw was used to cut the aluminium sheet covering the insulation and s... see Appendix Full Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident **country:** FA **ident key:** 1989_017_01

event:

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

initiating event 1307 explosion: VCE (vapour cloud explosion; supersonic wave front)

associated event 1202 fire: pool fire (burning pool of liquid, contained or uncontained)

Dangerous substances

country: FA **ident key:** 1989_017_01

a) total establishment inventory

CAS number: 107-13-1 **identity:** Acrylonitrile

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): 200

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 200 **potential quantity:** 200

c) substance belongs to relevant inventory indirectly involved: No

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

Source of Accident - Situation **country:** FA **ident key:** 1989_017_01

situation

industry

inititating event 2004 pesticides, pharmaceuticals, other fine chemicals

associated event 2004 pesticides, pharmaceuticals, other fine chemicals

activity/unit

major occurrence 3201 storage: process-associated (stockholding, etc. on-site of manufacture)

inititating event 3201 storage: process-associated (stockholding, etc. on-site of manufacture)

associated event 3201 storage: process-associated (stockholding, etc. on-site of manufacture)

component

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

inititating 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:** 1989_017_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 Measurements of the air-concentration down-wind were carried out to detect the p... see Appendix

Full Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk 6 250 250

immediate fatalities 3

subsequent fatalities

hospitalizing injuries 2

other serious injuries

health monitoring

remarks 3 people were killed and 2 injured by the explosion. One of the dead people was ... 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 ECU

material losses

response, clean up, restoration

remarks No data are available about the cost of the material damages caused by the explo... 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 Yes 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 Measurements of the air-concentration down-wind were carried out to detect the p... see Appendix

7 Discussion of Consequences

C Response Full Report

country: FA **ident key:** 1989_017_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

Strenghten of procedures and c... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

Evaluation of the communicatio... see Appendix Full Report C / lesson learned - mitigate

useful references:

- not applicable -

5 Discussion about Response

- not applicable -

Appendices for the FA / 1989_017_01 report

Appendix Short Report / description of accident types:

SYSTEM ORIGINATING AND OPERATING CONDITIONS:

Removal of insulation from all K1-tanks for scheduled maintenance. Work-permits issued by Paktank. Maintenance personnel was from an external company. The work permits contained some possible safety instructions, though none of them were specified.

OTHER SYSTEMS INVOLVED AND OPERATING CONDITIONS:

Heat radiation produced by fire required the cooling of the neighbouring tanks (shown in Annex II [scale 1:2000] attached to the Original Report). Cooling of approximately 18 tanks, then reduced to 4 tanks.

ENVIRONMENTAL AND ATMOSPHERIC CONDITIONS:

Wind direction 210¯, turning to 250¯, as shown in Annex III attached to the Original Report.

ACCIDENT CASE HISTORY DESCRIPTION:

- 09:38 An explosion occurred in the acrylonitrile tank, resulting in a tank fire.

- 09:40 Response of local fire brigade which first priority was to cool the neighbouring tanks. No attempt was carried out to control the fire.

- 10:30 Evacuation of nearby companies (approximately 250 people). Creation of Command Team on Site, according to normal procedure (police, fire brigade, harbour service, haz-mat experts, ambulances).

- 12:45 A first attempt to extinguish the fire with foam was carried out.

- 12:56 The fire was extinguished, but re-ignition occurred at 12:57.

- 13:48 A second attempt with foam was carried out and, after a short re-ignition, the fire was under control.

After the fire, the search for casualties started. Last person was found in the acrylonitrile tank and the removal of the body required the use of gastight suits.

Appendix Short Report / description of substances involved:

- Acrylonitrile (C.A.S. CODE: 107-13-1): amount involved during the explosion = 500 kg of vapours.

- Acrylonitrile (C.A.S. CODE: 107-13-1): amount involved during the fire = 200 tonnes.

Appendix Short Report / description of immediate sources:

The accident occurred during the removal of insulation from tanks for scheduled maintenance in a storage area of a petrochemical industry for loading, unloading and storage of various chemicals. The lay-out of the storage area is shown on Annex I and Annex II attached to the Original Report. The tank N¯ 823 where the explosion occurred was containing 200 tonnes of acrylonitrile. The nearby tanks were containing: tank N¯ 822 1034 tonnes on methylenechloride; tank N¯ 824 40 tonnes of methylacrylate; tank N¯ 825 was empty; tank N¯ 826 500 tonnes of ethylacrylate; tank N¯ 827 vinylacetate. The location of the factory is shown on Annex IV attached to the Original Report (the population density at the north side of the river was high).

Appendix Short Report / description of suspected causes:

INITIATING EVENT AND CONSEQUENCES:

During the removal of insulation from tank N¯ 823 (containing about 200 tonnes of acrylonitrile) for scheduled maintenance a tank sampling nozzle was opened to prevent uncontrolled escape of vapours. At 1.5 metre from the nozzle, an electrical saw was used to cut the aluminium sheet covering the insulation. Sparks caused the explosion of vapour phase in the tank.

CAUSES:

The combination of incorrect procedure (permission to carry out hot work on top of K-1 tanks) and human error in opening a tank during operation at hot work caused the accident. The rupture of the underground water-supply pipe was probably due to water-shock.

Appendix Short Report / description of immediate effects:

EFFECTS ON PEOPLE:

3 people were killed and 2 injured by the explosion. One of the dead people was found in the acrylonitrile tank and the removal of the body required the use of gastight suits.

MATERIAL LOSS:

No data are available about the cost of the material damages caused by the explosion.

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

Notice of the fire brigade, conform to the existing procedures. The cooling of the nearby 18 tanks was activated; after the rupture of a pipe in the underground water-supply-system, a fireboat took care of the water supply.

EXTERNAL TO THE ESTABLISHMENT:

Measurements of the air-concentration down-wind were carried out to detect the presence of hydrogen cyanide, acrylonitrile and nitrogen oxides. The population was alarmed. Evacuation of neighbouring companies by the harbour service and river police (approximately 250 people) was carried out. The total number of emergency personnel was 250 (60 of them were from the municipal fire brigade). The extents of the alerted and evacuated areas are shown on Annex III attached to the Original Report.

Appendix Short Report / description of immediate lessons learned:

When the Original Report was prepared, the judicial investigation was still in progress. The question of guilt is: Is storage of acrylonitrile without nitrogen-blanketing permitted ? In the Netherlands, inhibitor is the decisive factor.

The water supply capacity was re-calculated and checked. The response of the check was positive.

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

Strenghten of procedures and control on the conditions to issue working permits.

MEASURES TO MITIGATE THE EFFECTS OF THE ACCIDENTS:

Evaluation of the communication system, particularly with regard to the evacuation.

Appendix Full Report A / type of accident:

During the removal of insulation from all K1-tanks for scheduled maintenance a tank sampling nozzle was opened to prevent uncontrolled escape of vapours. At 1.5 metre

from the nozzle, an electrical saw was used to cut the aluminium sheet covering the insulation. Sparks caused the explosion of the acrylonitrile vapours/air in the tank (code 1307). The explosion was followed by a fire in the tank (code 1202) and the heat radiation required the cooling of the neighbouring tanks.

Appendix Full Report A / dangerous substances:

The total establishment and the potential directly involved inventorie of acrylonitrile refer to the contents of tank N¯ 823 where the explosion occurred. About 500 Kg of acrylonitrile were involved in the explosion; the residual amoun in the following fire. The nearby tanks (containing: tank N¯ 822 1034 tonnes on methylenechloride; tank N¯ 824 40 tonnes of methylacrylate; tank N¯ 825 was empty; tank N¯ 826 500 tonnes of ethylacrylate; tank N¯ 827 vinylacetate) were not involved in the accident.

Appendix Full Report A / source of accident - remarks:

The accident occurred during the removal of insulation from tanks (code 4003) for scheduled maintenance in a storage area (code 3201) of a petrochemical industry (code 2002) for loading, unloading and storage of various chemicals. The lay-out of the storage area is shown on Annex I and II attached to the Original Report. The location of the factory is shown on Annex IX (the population density at the north side of the river was high) attached to the Original Report.

Appendix Full Report A / causes of major occurrence:

During the removal of insulation from tank N¯ 823 a tank sampling nozzle was opened to prevent uncontrolled escape of vapours. At 1.5 metre from the nozzle, an electrical saw was used to cut the aluminium sheet covering the insulation and sparks caused the explosion. The combination of incorrect procedure (code 5303) and human error (code 5401) in opening a tank during hot work operation caused the accident. The rupture of the underground water-supply pipe was probably due to water-shock.

Appendix Full Report B / area concerned - remarks:

Measurements of the air-concentration down-wind were carried out to detect the presence of hydrogen cyanide, acrylonitrile and nitrogen oxides. The population was alarmed. Evacuation of neighbouring companies by the harbour service and river police (approximately 250 people). The total number of emergency personnel was 250 (60 of which were from the municipal fire brigade). The extents of the alerted and evacuated areas are shown on Annex III attached to the Original Report.

Appendix Full Report B / people:

3 people were killed and 2 injured by the explosion. One of the dead people was found in the acrylonitrile tank and the removal of the body required the use of gastight suits. The total number of emergency personnel was 250 (60 of them were from the municipal fire brigade). 250 people of neighbouring companies were evacuated.

Appendix Full Report B / ecological harm:

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

Appendix Full Report B / material loss:

No data are available about the cost of the material damages caused by the explosion.

Appendix Full Report B / disruption of community life:

Measurements of the air-concentration down-wind were carried out to detect the presence of hydrogen cyanide, acrylonitrile and nitrogen oxides. The population was alarmed. Evacuation of neighbouring companies by the harbour service and river police (approximately 250 people). The extents of the alerted and evacuated areas are shown on Annex III attached to the Original Report.

Appendix Full Report C / lesson learned - prevent:

Strenghten of procedures and control on the conditions to issue working permits.

Appendix Full Report C / lesson learned - mitigate:

Evaluation of the communication system, particularly with regard to the evacuation.

The water supply capacity was re-calculated and checked. The response of the check was positive.