

Explosion och brand på ett lagerområde i petrokemisk industri.

890202 MARS 1800_28

Vid underhållsarbete på en cylindrisk lagertank för bensen inträffade en explosion då en svetslåga antändes. Underhållsarbetet bestod i att göra ren anslutande rör, men då rören inte tömts fullständigt på explosiva ämnen inträffade olyckan. Explosionen spred sig till den angränsande tanken som exploderade med sådan kraft att den lyftes 1 m över marken. Lagertanken var fylld med bensen till följd av missförstånd mellan produktions- och underhållsavdelningarna. Produktionsavdelningen hade fått uppfattningen att underhållsarbetet var avslutat. Den påföljande branden släcktes snabbt med hjälp av befintlig skumsläckningsutrustning.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
bensen		15 m3
andra kolväten		

Skador:

Människor:	En person omkom och tre skadades av explosionen.
Materiella:	Lagertanken förstördes.
Miljö/ekologi:	Inga effekter rapporterade.
Infrastruktur:	Inga.

Erfarenheter redovisade (Ja/Nej): Ja

Förebyggande åtgärder anges och olyckan tillskrivs huvudsakligen dålig intern kommunikation mellan produktions- och underhållsavdelningarna.

Report Profile

Identification of Report:

country: FA ident key: 1800_028_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 02/02/1989 start: 09:00:00

finish: finish:

Establishment:

name:

address:

industry: 2002 petrochemical, refining, processing

Petrochemical (Production of Maleic Anhydride from Benzene and many other activities)

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

art. 7 (MAPP): No

art. 9 (safety report): No

Date of Report:

short: full:

Authority Reporting:

name:

address:

Authority Contact:

rep_cont_name:

rep_cont_phone:

rep_cont_fax:

Additional Comments:

a) - not applicable -

b) - not applicable -

c) - not applicable -

d) - not applicable -

e) - not applicable -

Short Report

country: FA **ident key:** 1800_028_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:

- Benzene (C.A.S. CODE: 71-43-2); amount involved = kg 13,200.

Immediate Sources of Accident:

storage: Yes **transfer:** No

process: Yes **other:** No

description:

The accident occurred during maintenance works of a fire fighting system of a tank in the benzene storage area of a petrochemical industry for the production of maleic anhydride from benzene. In this area there were two 50m3 storage tanks; ... see Appendix Short Report / description of immediate sources

Suspected Causes:

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

human: Yes **other:** No

description:

CAUSES:... 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: 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: 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:** 1800_028_01

1 Type of Accident

remarks: Maintenance works for installing some flanges on the fire-fighting system of

a storage tank were in progress in order to allow an operation test of the

foam circuit. The works consisted in cleaning the pipes internal (the

presence of small ... see Appendix Full Report A / type of accident

2 Dangerous Substances

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

benzene refer to the amount involved in the explosion and the subsequent

fire (about 15 m3). No data are available about the amount of benzene stored

in the two 50m3... see Appendix Full Report A / dangerous substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred during maintenance works of the fire fighting system

of a tank in the benzene storage area (code 3201) of a petrochemical

industry for the production of maleic anhydride from benzene (code 2002). In

this area there wer... 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 5302 organization: management attitude problem

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

5307 organization: process analysis (inadequate, incorrect)

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

5401 person: operator error

remarks: Investigations revealed that maintenance works were in progress though the tank had been filled with benzene and that the glass membrane of the foam chamber was missing, allowing benzene vapours into the foam pipes. The main cause of the ac... see Appendix Full Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA ident key: 1800_028_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: 1800_028_01

a) total establishment inventory

CAS number: 71-43-2 identity: Benzene

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): 13,2

use of substance as: STARTING MATERIAL

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 13,2 potential quantity: 13,2

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

Source of Accident - Situation country: FA ident key: 1800_028_01

situation

industry

initiating event 2002 petrochemical, refining, processing

associated event - not applicable -

activity/unit

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

initiating event 3201 storage: process-associated (stockholding, etc. 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: 1800_028_01

1 Area concerned

affected

extent of effects installation: Yes

establishment: Yes

off-site; local: No

off-site; regional: No

off-site; transboundary: No

illustration of effects - not applicable -

remarks The explosion destroyed the storage tank (it had been lifted for about 1m from t... see Appendix

Full Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk 4

immediate fatalities 1

subsequent fatalities

hospitalizing injuries 3

other serious injuries

health monitoring

remarks 1 person was killed and 3 injured by the explosion.... 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 The explosion destroyed the storage tank (it had been lifted for about 1m from t... 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: 1800_028_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:

After the accident, it was est... see Appendix Full Report C / lesson learned - mitigate

useful references:

- not applicable -

5 Discussion about Response

- not applicable -

Appendices for the FA / 1800_028_01 report

Appendix Short Report / description of accident types:

ACCIDENT CASE HISTORY DESCRIPTION:

On February 2, 1989 maintenance works for installing some flanges on the fire-fighting system of the storage tank were in progress in order to allow an operation test of the foam circuit. The works consisted in cleaning the pipes internal (the presence of small holes was also suspected). The foam pipe had been already cut and, when a worker attempted to light a torch by a briquet, an explosion occurred. The subsequent fire was quickly extinguished by application of suitable foam already available in the establishment.

The activities relevant to this maintenance works can be summarized as follows: - 16/12/88: Operations department requested the verification of the fire fighting system. The maintenance department took over the activities and called an external contractor. The extent of works was normally defined by maintenance department without the intervention of operation department. The aim was to repair the network by installing flanges and perform a hydraulic pressure test. Hence the presence of small holes on the fire water pipes can be suspected. These works had to be performed over an empty tank and piping.

- 25/01/89: Initiation of maintenance works.

- 26/01/89: Interruption of maintenance works according to the instructions of the maintenance department because more urgent works had to be executed in another part of the plant.

- 30/01/89: Production department put the storage tank again in operation by filling it up with benzene, believing that maintenance works had been completed.

- 02/02/89: Maintenance department ordered maintenance works to be resumed since they had not been informed by the production department that the storage tank had been put in service. The work permit had been also erroneously co-signed by the production department. When a worker lighted the torch a fire started at the open foam pipe and through this was transmitted to the storage tank which exploded.

Appendix Short Report / description of immediate sources:

The accident occurred during maintenance works of a fire fighting system of a tank in the benzene storage area of a petrochemical industry for the production of maleic anhydride from benzene. In this area there were two 50m³ storage tanks; a third tank (with a volumetric capacity of 1,000m³), initially containing styrene, was converted to benzene storage. It was a vertical cylindrical tank operating at atmospheric pressure and located at the right side of a retention basin with a capacity of 2,000m³. Sketches of the storage tank arrangement and of the fire-fighting system are shown in two Annexes to the Original Report.

Appendix Short Report / description of suspected causes:

CAUSES:

Investigations revealed that maintenance works were in progress though the tank had been filled with benzene and that the glass membrane of the foam chamber was missing, allowing benzene vapours into the foam pipes. The main cause of the accident was the lack of coordination between the maintenance and the production departments because:

- no information of production department on the progress of maintenance work;
- the maintenance department was not informed by the production department that storage tank had been put again in operation;
- the production department signed the work-permit though the tank had been filled with benzene;
- the change of service (from styrene to benzene) was not declared according to the procedures and therefore the maintenance department responsible for the execution of these works had not been informed that the tank was filled with benzene;
- the glass membrane on the foam chamber was missing;
- no nitrogen blanketing was used in storing benzene in a fixed-roof tank.

Appendix Short Report / description of immediate effects:

EFFECTS ON PEOPLE:

1 person was killed and 3 injured by the explosion.

MATERIAL LOSS:

The explosion destroyed the storage tank (it had been lifted for about 1m from the ground and landed on a side) but no data are available about its cost.

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

Protection of the ?? by cooling with water. The subsequent fire was quickly extinguished by application of suitable foam already available in the establishment.

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- compilation of written maintenance procedures;
- 2- introduction of quality assurance procedure for maintenance works;
- 3- use of nitrogen blanketing in fixed roof tanks storing highly flammable liquids (this point had been mandatory for critical atmospheric tanks).

MEASURES TO MITIGATE THE EFFECTS OF THE ACCIDENT:

After the accident, it was established to use weak roof-to-shell seams (this point had been mandatory for critical atmospheric tanks) in order to allow the rupture of the roof instead of the bottom part of the tank in case of internal overpressure. A guideline for this point had been established by the Environment Minister together with Norsolor firm.

Appendix Full Report A / type of accident:

Maintenance works for installing some flanges on the fire-fighting system of a storage tank were in progress in order to allow an operation test of the foam circuit. The works consisted in cleaning the pipes internal (the presence of small holes was also suspected). The foam pipe had been already cut and, when a worker attempted to light a torch by a briquet, an explosion occurred (code 1307). The explosion was followed by the fire of the stored benzene (code 1202).

Appendix Full Report A / dangerous substances:

The total establishment and the potential directly involved inventories of benzene refer to the amount involved in the explosion and the subsequent fire (about 15 m³). No data are available about the amount of benzene stored in the two 50m³ storage tanks.

Appendix Full Report A / source of accident - remarks:

The accident occurred during maintenance works of the fire fighting system of a tank in the benzene storage area (code 3201) of a petrochemical industry for the production of maleic anhydride from benzene (code 2002). In this area there were two 50m³ storage tanks; a third tank (with a volumetric capacity of 1,000m³), initially containing styrene, was converted to benzene storage. It was a vertical cylindrical tank operating at atmospheric pressure (code 4003).

Appendix Full Report A / causes of major occurrence:

Investigations revealed that maintenance works were in progress though the tank had been filled with benzene and that the glass membrane of the foam chamber was missing, allowing benzene vapours into the foam pipes. The main cause of the accident was the lack of coordination between the maintenance and the production departments (codes 5401, 5302 and 5303). No nitrogen blanketing was used in storing benzene in a fixed-roof tank (codes 5307 and 5308).

Appendix Full Report B / area concerned - remarks:

The explosion destroyed the storage tank (it had been lifted for about 1m from the ground and landed on a side) but in the Original Report there is no evidence of significant effects outside the establishment.

Appendix Full Report B / people:

1 person was killed and 3 injured by the explosion.

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 explosion destroyed the storage tank (it had been lifted for about 1m from the ground and landed on a side) but no data are available about its cost.

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- compilation of written maintenance procedures;
- 2- introduction of quality assurance procedure for maintenance works;
- 3- use of nitrogen blanketing in fixed roof tanks storing highly flammable liquids (this point had been mandatory for critical atmospheric tanks).

Appendix Full Report C / lesson learned - mitigate:

After the accident, it was established to use weak roof-to-shell seams (this point had been mandatory for critical atmospheric tanks) in order to allow the rupture of the roof instead of the bottom part of the tank in case of internal overpressure. A guideline for this point had been established by the Environment Minister together with Norsolor firm.