

# Brand på ett oljeraffinaderi.

870313 MARS 1987\_14

Brand inträffade på ett oljeraffinaderi i samband med underhållsarbete . Tidigt 1986 upptäcktes att gas som borde gå till återvinning istället gick till facklan för förbränning. Man fann att det berodde på en ventil som inte slöt tätt. Det beslutades att reparera ventilen. Man ansåg att det krävde noggrann planering för att inte störa produktionen. Efter något år kom ett lämpligt tillfälle och arbetsordern undertecknades. Inga problem hade förutsetts eftersom arbetet ansågs vara rutinmässigt. Tre reparatörer skulle utföra arbetet på ventilen, hjälpta av två av raffinaderiets brandmän. Då ventilen öppnades forade en störtflod av petroleum och petroleumångor ut över plattformen och rann ner till marken. Ångorna antändes av en motor till en kompressor i närheten. Männen på plattformen sveptes in i eldslågor. Två omkom och två skadades. Företagets interna brandkår anlände omedelbart. Inom några minuter anlände även räddningstjänsten. Branden var begränsad till arbetsområdet. Alla enheter som kunde tänkas bidra till fortsatt brand stängdes av. Kvävgasrening av facklans tillflöden inleddes.

Ventilen hade fallerat på grund av avlagringar genom åren. Flagor hade lösts upp av petroleumångor och bildat ett trögflytande slam som förhindrat ventilen att sluta tätt. Slammet hade dessutom förhindrat dränering med den konsekvensen att ansenliga mängder vätska ansamlats. Det var dessa ansamlingar som orsakade olyckan.

## Inblandade ämnen och mängder

	CAS Nr.	Mängd
gasformiga och flytande lättantändliga petroleumprodukter		10 ton

## Skador:

Människor:	Två människor omkom och två skadades i branden.
Materiella:	Begränsade skador på anläggningen.
Miljö/ekologi:	Inga effekter rapporterade.
Infrastruktur:	Inga.

## Erfarenheter redovisade (Ja/Nej): Ja

Förebyggande åtgärder anges.

## Report Profile

### Identification of Report:

country: FA ident key: 1987\_014\_01

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

### Date of Major Occurrence: Time of Major Occurrence

start: 1987-03-13 start: 15:00:00

finish: finish:

### Establishment:

name:

address:

industry: 2002 petrochemical, refining, processing

Petroleum Refinery (Hydrocracking of Heavy Oils to Spirits and Gases)

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\_014\_01

**Accident Types:**

release: Yes explosion: No

water contamination: No other: No

fire: Yes

**description:**

The ambient temperature was near freezing and this allowed significant liquid to condense out in the flare pipelines. Wind conditions were slight and the vapours from the spilling liquid were not dispersed.... see

Appendix Short Report / description of accident types

**Substance(s) Directly Involved:**

toxic: No explosive: Yes

ecotoxic: No other: No

flammable: Yes

**description:**

- Low Flash-Point Petroleum Liquids and Spirits: amount involved = 10,000 kg.

**Immediate Sources of Accident:**

storage: No transfer: No

process: Yes other: No

**description:**

The accident occurred in a section of the refinery flare system of a large oil refinery specialized in cracking heavy oils to spirits and gases (about 7 millions tonnes per year). About 1,200 people were employed

and up to 1,000 contractor... see Appendix Short Report / description of immediate sources

### **Suspected Causes:**

**plant or equipment:** Yes **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:** 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:** 1987\_014\_01

### **1 Type of Accident**

**remarks:** When a ring spacer was pulled free during the removal of a gas valve,

torrents of petroleum spirits gushed out to cascade down to the ground below

(code 1102). The liquid was ignited by a nearby air compressor engine (used

to supply air for... see Appendix Full Report A / type of accident

### **2 Dangerous Substances**

**remarks:** The total establishment and the actual directly involved inventories refer

to the amount of the low-flash petroleum liquids and spirits released during

the accident.

### 3 Source of Accident

**illustration:** - not applicable -

**remarks:** The accident occurred in a section of the refinery flare system (code 3301)

of a large oil refinery (code 2002) specialized in cracking heavy oils to

spirits and gases (7 millions tonnes/year). About 1,200 people were

employed and up to 1... 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:** The ambient temperature was near freezing and this allowed significant liquid to condense

out in the flare pipelines. Wind conditions were slight and the vapours from the released

liquid were not dispersed.

### 5 Causes of Major Occurrence

**main causes**

**technical / physical** 5108 operation: blockage

- not applicable -

- not applicable -

- not applicable -

- not applicable -

**human / organizational** 5302 organization: management attitude problem

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

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

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

5313 organization: maintenance/repair (none, inadequate, inappropriate)

**remarks:** The cause of the accident was the blockage (code 5108), due to the presence of sludge, of

the flare line isolation valves. The underlying causes were: refinery staff assumed that

the work would be routine (code 5302) and that general precau... see Appendix Full Report

A / causes of major occurrence

### 6 Discussion about the Occurrence

- not applicable -

**Type of Accident** country: FA ident key: 1987\_014\_01

**event:**

**major occurrence** 1202 fire: pool fire (burning pool of liquid, contained or uncontained)

**initiating event** 1102 release: fluid release to ground

**associated event** - not applicable -

## **Dangerous substances**

**country:** FA **ident key:** 1987\_014\_01

### **a) total establishment inventory**

**CAS number:** **identity:** Petroleum Liquids And Spirits

**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):** 10

**use of substance as:** NORMAL FINISHED PRODUCT

**b) substance belongs to relevant inventory directly involved:** Yes

**actual quantity:** 10 **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\_014\_01

## **situation**

### **industry**

**initiating event** 2002 petrochemical, refining, processing

**associated event** - not applicable -

### **activity/unit**

**major occurrence** 3402 other: disposal activities (incinerating, burying, etc.)

**initiating event** 3402 other: disposal activities (incinerating, burying, etc.)

**associated event** - not applicable -

### **component**

**major occurrence** 4999 other

**initiating event** 4010 valves/controls/monitoring devices/drain cocks

**associated event** - not applicable -

## **B Consequences Full Report**

**country:** FA **ident key:** 1987\_014\_01

### **1 Area concerned**

**affected**

**extent of effects installation:** Yes

**establishment:** No

**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 w... see Appendix

Full Report B / area concerned - remarks

## **2 People**

**establishment popul. emergency personnel off-site population**

**total at risk** 8

**immediate fatalities** 2

**subsequent fatalities**

**hospitalizing injuries** 2

**other serious injuries**

**health monitoring**

**remarks** When the liquid was ignited, the scaffold platform and the people on it were env... 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 British Pounds ECU British Pounds**

**material losses** 200000

**response, clean up, restoration**

**remarks** The fire was readily confined to the work area and, therefore, damages were suff... 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** The usual response on receipt of an emergency call for a fire at the refinery wa... see Appendix

## 7 Discussion of Consequences

# C Response Full Report

**country:** FA **ident key:** 1987\_014\_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, the follow... see Appendix Full Report C / lesson learned - mitigate

useful references:

- not applicable -

### **5 Discussion about Response**

- not applicable -

## **Appendices for the FA / 1987\_014\_01 report**

### **Appendix Short Report / description of accident types:**

The ambient temperature was near freezing and this allowed significant liquid to condense out in the flare pipelines. Wind conditions were slight and the vapours from the spilling liquid were not dispersed.

In early 1986 it was noted that the flare gas recovery system was operating at reduced efficiency. Gas which should have been recovered was being routed instead to flare. Investigation revealed that a 750 mm valve was passing gas when in closed position. A decision was taken to have the valve removed to carry out repairs to it. It was appreciated that there would require to be careful planning to prevent the possibility of leave refinery units being inadvertently isolated from the flare system. One of the flares would have to be taken out of service and therefore the potential flaring demand of the refinery would need to be matched to the remaining two flares. At a number of meetings of operational and maintenance staff, an agreed flare alignment procedure was drawn up outlining flare system conditions necessary for removal of the valve. The earliest time to carry out the work was to be in early 1987 when 2 of the refinery units and flare N<sup>o</sup> 1 were planned to be out of service for routine maintenance. The detailed work methods and safety requirements concerned with the actual removal of the valve were not considered at the meeting. No difficulties were foreseen and the works were organized and arranged by operations department technicians. Few days prior the accident, the valves to isolate live parts of the flare system from the section under maintenance were closed. Immediately prior to work commencing, the BP technician checked the status of isolation valves and he also identify conditions in the isolated section by opening a small valve on the liquid drain line at a distant flare knockout drum. Finding no indication of gas or liquid coming from the valve he assumed that the flare line was isolated, depressurised and free of liquid. Near the work station were located 2 water monitors to disperse residual gas if it should flow out when the valve was removed. Two refinery fire-fighters were present to operate the monitors and to oversee the use of the breathing apparatuses being used by the workers as protection against potentially toxic residual gases in the flare line. Also in the work area there was a crane to lift the heavy valve and a diesel engine compressor to supply air for the breathing apparatuses. Being everything in order, the BP technician issued the permit to the contractor and work commenced. Two fitters and a rigger prepared to remove a flange ring spacer to insert a blank spade in its taken by a crane. Suddenly it pulled upwards and torrents of liquid gushed out to cascade down over the scaffold. Gases from the spilled liquid spread over the ground igniting on the engine of the air spread to cover the pool of liquid and envelop the scaffold and the men in a raging inferno.

### **Appendix Short Report / description of immediate sources:**

The accident occurred in a section of the refinery flare system of a large oil refinery specialized in cracking heavy oils to spirits and gases (about 7 millions tonnes per year). About 1,200 people were employed and up to 1,000 contractor staff used at major maintenance works. The accident occurred on a 750 mm diameter elevated flare line around which a scaffold platform had been erected to assist in the removal of a gate valve. The flare line in the vicinity of the valve was supposed isolated from other working parts of the flare system, drained and tested. The plant lay-out is shown on a map attached to the Original Report.

### **Appendix Short Report / description of suspected causes:**

#### INITIATING EVENT AND CONSEQUENCES:

When a ring spacer was pulled free during the removal of a gate valve, torrents of petroleum spirits gushed out to cascade down to the ground below. The liquid was ignited by a nearby air compressor engine (used to supply air for the breathing apparatuses of the maintenance crew) and a pool fire occurred. The scaffold platform and the people on it were enveloped in flames.

#### CAUSES:

It soon became apparent that in the flare pipework scale had formed over the years. This scale had flaked off from internal surfaces to accumulate at the bottom of the flare pipelines where it turned into a thick viscous-sludge in the presence of vented and condensed hydrocarbon liquids. The sludge had found its way into the guides of flare line wedge gate valves which where thus prevented from closing fully. Sludge had also passed down liquid drain lines at the knock-out drums to cause them to block.

Therefore the normal drainage built into the flare system no longer operated and as a result substantial quantities of liquid accumulated. The flare line isolation valves had no means of indicating their fully closed position. It was assumed that exerting considerable force on the handles of valves was sufficient indication. Many of the suppose closed valves were found to be jammed and were still allowing free passages of gas. The pipe to the valve used to test line conditions was also blocked with sludge. Therefore presence of liquids and gases in the line was not identified when the valve was open. Furthermore, the technician judged that residual flammable gases in the flare pipe presented no significant fire hazard. Therefore the system was not purged with inert nitrogen nor steam. In addition, the flare drainage was not verified as being clear of blockages nor the valves as being clear obstruction by the use of injected steam.

Work methods have not been planned to take sufficient account of the risk of residual liquid being present in the flare.

### **Appendix Short Report / description of immediate effects:**

#### EFFECTS ON PEOPLE:

When the liquid was ignited, the scaffold platform and the people on it were engulfed in flames. Two people were killed and two others people were injured by fire.

#### MATERIAL LOSS:

The fire was readily confined to the work area and, therefore, damages were suffered only in its proximity (to pipelines, to electrical cables/equipments, to the crane and to the breathing air compressor). The cost of the material damages has been estimated in about 200,000 U.K.P. (about 0.28 MECU).

### **Appendix Short Report / description of emergency measures taken:**

#### INTERNAL TO THE ESTABLISHMENT:

The refinery fire brigade was called and quickly arrived on the scene to assist the two stand-by firefighters already fighting the fire. A few minutes later, units of the local fire brigade arrived. The fire was readily confined to the work area. To ensure that recovery of the bodies could be carried out in safety, all operating refinery units which could have continued in feeding into the flare system, were shut-down. Nitrogen gas purging of the flare lines was commenced.

#### EXTERNAL TO THE ESTABLISHMENT:

The usual response on receipt of an emergency call for a fire at the refinery, was to commence off-site procedures. However, they were stood down within a short time as it became apparent that there would be no major hazard nor off-site risks.

### **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- any work on the refinery flare system has now to be authorised at senior management level. There is no formal requirement for the planning of work to take into account all potential risks. Work methods and safety precautions must be detailed in writing and agreed by representatives from a number of refinery departments who in turn will closely monitor work as it progresses;
- 2- each valve should have an indication of its position and at the base of critical isolation valves have been added orifices to which steam can be injected to dissolve blockages;
- 3- verify the performance of flare drainage;

- 4- purge lines with inert nitrogen gas to clear residual flammable gases and to prevent air from reaching any pyrophoric scale inside the pipes;
- 5- move flanges apart gradually with bolts still in position until the contents of the line can be positively identified;
- 6- use trays under the flanges as they are moved apart to collect liquids in a safe way;
- 7- avoid diesel-engine operated compressors nearby; at locations to which the refinery air system does not extend, mobile air storage tanks should be provided for breathing apparatuses.

#### MEASURES TO MITIGATE THE CONSEQUENCES OF THE ACCIDENT:

After the accident, the following measures were established:

- 1- alternative escape routes from scaffold platforms or any work area must always be available;
- 2- staff on the work must be equipped with flash-fire suits;
- 3- remove personnel away when the final lift is carried out;
- 4- drench the valve removal area and scaffold platforms with ground-level fire monitors as the lift is carried out;
- 5- provide a refinery fire tender on stand-by at the scene.

#### **Appendix Full Report A / type of accident:**

When a ring spacer was pulled free during the removal of a gas valve, torrents of petroleum spirits gushed out to cascade down to the ground below (code 1102). The liquid was ignited by a nearby air compressor engine (used to supply air for the breathing apparatuses of the maintenance crew) and a pool fire occurred (code 1202).

#### **Appendix Full Report A / source of accident - remarks:**

The accident occurred in a section of the refinery flare system (code 3301) of a large oil refinery (code 2002) specialized in cracking heavy oils to spirits and gases (7 millions tonnes/year). About 1,200 people were employed and up to 1,000 contractors staff used at major maintenance works. The component involved in the liquid release was a gate valve under removal (code 4010). The liquid was ignited and the fire enveloped the scaffold platform and the people on it in flames (code 4999).

#### **Appendix Full Report A / causes of major occurrence:**

The cause of the accident was the blockage (code 5108), due to the presence of sludge, of the flare line isolation valves. The underlying causes were: refinery staff assumed that the work would be routine (code 5302) and that general precautions would be sufficient (code 5303); the technician was inexperienced (code 5304); the maintenance/testing procedures of the flare system were not sufficient (codes 5313 and 5314); the design of equipment was not adequate (code 5308).

#### **Appendix Full Report B / area concerned - remarks:**

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

#### **Appendix Full Report B / people:**

When the liquid was ignited, the scaffold platform and the people on it were enveloped in flames. Two people were killed and two others people were injured by fire.

#### **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 fire was readily confined to the work area and, therefore, damages were suffered only in its proximity (to pipelines, to electrical cabs/equipments, to crane and to breathing air compressor). The cost of the damages has been estimated in about 0.28 MECU (about 200,000 U.K.P.).

#### **Appendix Full Report B / disruption of community life:**

The usual response on receipt of an emergency call for a fire at the refinery was to commence off-site procedures. However, they were stood down within a short time as it became apparent that there would be no major hazard nor off-site risks (in the Original Report there is no evidence of significant effects outside the work area).

#### **Appendix Full Report C / lesson learned - prevent:**

After the accident, the following measures were established:

- 1- any work on the refinery flare system has now to be authorised at senior management level. There is no formal requirement for the planning of work to take into account all potential risks. Work methods and safety precautions must be detailed in writing and agreed by representatives from a number of refinery departments who in turn will closely monitor work as it progresses;
- 2- each valve should have an indication of its position and at the base of critical isolation valves have been added orifices to which steam can be injected to dissolve blockages;
- 3- verify the performance of flare drainage;
- 4- purge lines with inert nitrogen gas to clear residual flammable gases and to prevent air from reaching any pyrophoric scale inside the pipes;
- 5- move flanges apart gradually with bolts still in position until the contents of the line can be positively identified;
- 6- use trays under the flanges as they are moved apart to collect liquids in a safe way;
- 7- avoid diesel-engine operated compressors nearby; at locations to which the refinery air system does not extend, mobile air storage tanks should be provided for breathing apparatuses.

#### **Appendix Full Report C / lesson learned - mitigate:**

After the accident, the following measures were established:

- 1- alternative escape routes from scaffold platforms or any work area must always be available;
- 2- staff on the work must be equipped with flash-fire suits;
- 3- remove personnel away when the final lift is carried out;
- 4- drench the valve removal area and scaffold platforms with ground-level fire monitors as the lift is carried out;
- 5- provide a refinery fire tender on stand-by at the scene.