

1258215 July 2100

Source : DUST EXPLOSIONS IN THE PROCESS INDUSTRIES. ECKHOFF.

Location : Fonda, Iowa, USA

Injured : 0 **Dead :** 0

Abstract

Electrical welding on a bucket elevator lead to a dust explosion in the elevator, which was passed to another. The damage was estimated at US\$ 0.03 million (1980).

[damage to equipment, safety procedures inadequate]

Lessons

The bucket elevators needed explosion relief

1299214 August 2000

Source : BBC NEWS, 15 AUGUST, 2000, (<http://www.bbc.co.uk>).

Location : Uganda, AFRICA

Injured : 10 **Dead** : 18

Abstract

A fire occurred killing eighteen people and injuring ten when a burning cigarette caused petrol from a fuel tanker to catch fire as villagers were attempting to siphon fuel from the overturned tanker.

[fire - consequence, road tanker, fatality, burns, injury]

Lessons

[None Reported]

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 25 APRIL, 2000, (<http://www.chemsafety.gov>),

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Location : Jersey City, New Jersey, USA

Injured : 1 **Dead :** 0

Abstract

A worker suffered frostbite to his lungs and asphyxia after breathing in nitrogen. The incident occurred when he connected a nitrogen line instead of oxygen, to his protective hood.

The worker was immediately rushed to hospital after workers realised he had mistakenly hooked the wrong lines.

[asphyxiation, operator error, breathing apparatus, injury]

Lessons

[None Reported]

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 30 APRIL, 2000, (<http://www.chemsafety.gov>)

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Location : Bossier City, USA

Injured : 0 **Dead :** 2

Abstract

A worker collapsed after entering a chemical tanker trailer with out breathing equipment to rescue an unconscious co-worker. Both workers died presumably from the effects of naphtha fumes.

Naphtha is often used for dry cleaning. Acute exposure can damage the central nervous system, according to OSHA guidelines.

[entry into confined space, safety procedures inadequate, road tanker, asphyxiation, fatality]

Lessons

[None Reported]

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 18 APRIL, 2000, (<http://www.chemsafety.gov>),

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Location : Edmonton, Alberta, CANADA

Injured : 0 **Dead :** 1

Abstract

An explosion occurred during cutting operations at a drywall facility. The incident occurred when a worker burned a hole in the top a 45-gallon drum he was using as a worktable whilst cutting a piece of steel.

[drums, hot work, safety procedures inadequate, fatality, fire - consequence]

Lessons

[None Reported]

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 14 MARCH, 2000, (<http://www.chemsafety.gov>).

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Location : Rock Hill, USA

Injured : 2 **Dead :** 2

Abstract

Two workers were killed and two injured when turpentine fumes ignited during welding operations on a tank at a paper plant.

The tank was used to collect liquid product during the papermaking process.

Approximately fifty workers were evacuated.

[evacuation, fire - consequence, fatality, safety procedures inadequate, injury]

Lessons

[None Reported]

Source : CNN.COM, U.S. NEWS, 12 MARCH, 2000, (<http://www.cnn.com>).
CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, MARCH 21, 2000,
(<http://www.chemsafety.gov>).

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Location : Krasnodon, UKRAINE

Injured : 6+ **Dead :** 81+

Abstract

A coal dust explosion occurred at 2,191 feet underground killing 81 miners and injuring 6.

It is thought that coal dust and methane may have caused the explosion.

An investigation into the incident found that the cause might have been due to a faulty cutting torch, which released a stream of oxygen and caused coal dust to explode.

[fatality, safety procedures inadequate, injury, mining]

Lessons

[None Reported]

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, JANUARY 15, 2000, (<http://www.chemsafety.gov>).

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Location : St Petersburg, USA**Injured :** 1 **Dead :** 0**Abstract**

A gas pipeline ruptured during construction work. A contractor was digging a hole in a highway when he hit the 2-inch natural gas line.

A gas employee who responded to the leak climbed into the 6-foot hole but was overcome by the gas. He passed out, fortunately three fire fighters managed to lift him to the surface and revive him with oxygen.

[operator error, asphyxiation, injury]

Lessons

[None Reported]

Source : CNN.COM, U.S. NEWS, NOVEMBER 23, 1999,
(<http://www.cnn.com>).

Location : , USA

Injured : 5 Dead : 1

Abstract

Workers on a construction site were pouring concrete when part of the building they were working on collapsed, plunging them three stories and burying them in debris and wet concrete.

One worker was killed and five injured.

[fatality, fall, safety procedures inadequate, injury]

Lessons

[None Reported]

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, JANUARY 24, 2000, (<http://www.chemsafety.gov>).

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Location : , CHINA

Injured : 1 **Dead :** 3

Abstract

Cleaning operations were being carried out in a storage tank when an explosion occurred killing three workers and injuring another.

The explosion and fire seriously damaged the 34,000 kl tank.

Cigarettes and a lighter were discovered near the workers bodies.

The policy at the refinery strictly forbids taking cigarettes and cellular phones into tanks to be cleaned.

[storage tanks, fire - consequence, fatality, injury]

Lessons

[None Reported]

1209501 October 1999

Source : CHEMICAL HAZARDS IN INDUSTRY, DECEMBER 1999,; PLAST. NEWS, 4 OCT 1999, <http://www.plasticsnews.com>

Location :

Injured : 0 Dead : 0

Abstract

515,000 pounds of polyvinyl chloride (PVC) and 30,000 pounds of polypropylene was destroyed by a fire which occurred at a plastics plant. Two of the plants fire doors did not work and there was only time to close one of the fire doors. Maintenance had not been carried out on the doors for a number of years. Fortunately, firewalls prevented the blaze from reaching manufacturing and office areas.
[fire - consequence, safety equipment failure]

Lessons

[None Reported]

Source : ENVIRONMENTAL TIMES, VOLUME 6, ISSUE 3, SPRING 2000.

Location : Dorset, UK

Injured : 0 Dead : 0

Abstract

A chromic acid, a toxic heavy metal used in metal plating process spilled into a ditch. The ditch flows into a conservation site. Most of the acid contaminating the ditch was prevented from reaching the conservation site by damming the ditch and pumping the acid into temporary storage tanks.

Poor maintenance had allowed the acid to leak.

The company was fined £3,255 and costs of £9,500 (2000).

[leak, maintenance inadequate, pollution]

Lessons

[None Reported]

Source : CHEMICAL HAZARDS IN INDUSTRY, DECEMBER 1999,; SAFETY ONLINE, 7 SEP 1999, <http://www.safetyon-line.com/>

Location : , NORTHERN RUSSIA

Injured : 3 Dead : 4

Abstract

An explosion occurred at an ore processing plant killing four workers and injuring three others. The incident occurred when three oxygen cylinders exploded during welding operations. An investigation into the incident is being carried out. It is thought that the cause was due to a breach of company safety rules. [safety procedures inadequate, fatality, injury]

Lessons

[None Reported]

Source : YAHOO NEWS UK & IRELAND, SEPTEMBER 3, 1999, (<http://www.yahoo.co.uk>).

Location : , UK

Injured : 31 Dead : 0

Abstract

Thirty one workers were sent to hospital suffering breathing problems and nausea after a chemical leak at a warehouse. The workers were under observation after formaldehyde escapes from a container at the warehouse.

It is thought that a forklift truck punctured a container in a chemical handling area.

[gas / vapour release, warehousing, fracture, operator error, people]

Lessons

[None Reported]

Source : CHEMICAL HAZARDS IN INDUSTRY, NOVEMBER 1999.; J. OCCUP. HEALTH SAF. AUST. N. Z., AUG 1999, 15(4), 298.

Location : , AUSTRALIA

Injured : 0 Dead : 0

Abstract

A furniture factory was completely destroyed by two workers. A cigarette lighter was used to ignite a stream of lacquer from a spray gun. Burning vapour was drawn into the extraction system of the spray booth causing the filters to ignite. Despite workers efforts, the fire spread to all parts of the factory.
[fire - consequence, deliberate acts, plant / property / equipment]

Lessons

[None Reported]

1208231 July 1999

Source : CHEMICAL HAZARDS IN INDUSRY, OCTOBER 1999,; PLASTIC NEWS, 9 AUG, 1999.

Location :

Injured : 0 **Dead :** 1

Abstract

A worker was killed in an injection moulding machine at a plastics plant. The materials handler had reached into the machine to retrieve a part, his head was crushed in the incident.

[fatality, normal operations, safety procedures inadequate]

Lessons

[None Reported]

12377May 1999

Source : CHEMICAL HAZARDS IN INDUSTRY, MARCH 2000,; SAFETY MANAGEMENT, (LONDON), JAN 2000, 30-31.

Location : , UK

Injured : 1 Dead : 0

Abstract

A plastics manufacturing company were fined £5000 (1999) following an accident in which a worker was injured.

The incident occurred whilst a machine operative was attempting to adjust a roller unit. The machine had an exterior mechanism to enable adjustments to be made.

However, at the time of the incident the mechanism was not working and the company had installed a metal jack inside the machine to allow manual adjustment.

The operator removed a guard and it is thought the jack fell out of the machine, knocking the operator's hand onto a rotating metal chain.

As a result the operator's hand was caught in the machine inflicting severe injury. One of the operator's fingers was amputated as a result.

[safety procedures inadequate, operational activities, mechanical handling equipment, injury]

Lessons

[None Reported]

Source : CHEMICAL HAZARDS IN INDUSTRY, MARCH 2000,; FIRE PREVENTION, JAN 2000, (328), 40

Location : Staffordshire, UK

Injured : 0 Dead : 0

Abstract

A fire occurred at a storage yard storing plastic pipes. The fire caused an estimated damage of £750,000 (1999).

The yard contained polyethylene and PVC pipes stacked at heights of 2-6 metres.

Fire fighters and fork lift truck drivers created a fire break between stored stock.

An investigation into the incident found a carelessly discarded cigarette-end in a rubbish bin and the subsequent ignition of a plastic pipe was the most likely cause of the fire.

[fire - consequence]

Lessons

[None Reported]

12610 April 1999

Source : ENVIRONMENTAL TIMES, VOLUME 6, ISSUE 3, SPRING 2000.

Location : Devon, UK

Injured : 0 Dead : 0

Abstract

Raw sewage spilled into a drainage ditch from a pumping station. The incident occurred when the standby pump had been moved for repair and had not been replaced. The remaining pump had become air locked, and with no back up, sewage began to overflow and spill into the ditch.

A failure of the company's warning system meant the problem had been left undetected.

The company was fined £5,000 and costs of £300 (2000).

[drains & sewers, maintenance inadequate, waste, pollution, design or procedure error]

Lessons

[None Reported]

118791999

Source : BBC NEWS, SEPTEMBER 13, 1999, (<http://www.bbc.co.uk>).

Location : , UK

Injured : 0 Dead : 1

Abstract

A manhole cover had been left off an access pit causing a worker to fall 20 ft, the worker died from the fall.

The worker fell through the open manhole while walking through a dimly lit corridor.

The company was fined £200,000 (1999) plus £3,500 (1999) towards prosecution costs.

[fatality, safety procedures inadequate]

Lessons

[None Reported]

1072815 October 1998

Source : BBC NEWS, OCT 19, 1998, (<http://www.bbc.co.uk>).

Location : , AFRICA

Injured : - Dead : 100+

Abstract

A fire and explosion occurred on a ruptured pipeline.

Local people were scooping up the leaking fuel from the pipeline when there was an explosion.

It is thought that ignition was caused by a spark from either a cigarette or a motorbike engine.

Many of the victims had become saturated by fuel.

[burns, fatality, fracture, transportation]

Lessons

[None Reported]

Source : ICHEME**Location :** , UK**Injured :** 1 **Dead :** 0**Abstract**

Part of a benzene plant was shutdown, as part of the annual shutdown programme. As part of the preparations for maintenance the main process sections were drained, purged and steamed in accordance with the set procedures. Work then began on the stripper column reboiler circuit, including two heat exchangers. The actions required for the preparation of one of the exchangers had been highlighted, and so it was assumed these actions had been completed. Under a Permit to Work the foreman and 4 of his team commenced on unbolting the exchanger end plate and the main channel end flange. The work was not completed and was carried forward to the next shift. During the work it was noticed that the exchanger surface was still hot. This was assumed to be due to steaming operations in the shell side of the exchanger. The following day under a re-signed Permit to Work, the team continued with unbolting and the exchanger end plate seal was released. Hot condensate spilled out of the bottom section of the exchanger end channel. When the flow ceased the final bolts were removed from the end plate flange and the end plate cover was rigged ready for lifting down to ground level. Approximately 10 minutes after the end plate was removed, a fitter working adjacent to the area was hit by a large flow of hot condensate, which flowed from the exchanger, impinged on a tube baffle plate and then sprayed over the fitter. He crawled away and colleagues put him under a safety shower until the ambulance arrived. The fitter received scalds to his back and neck. Investigations showed that there had been ineffective isolation of the exchanger system from the live LP plant steam supply. There were also passing valves on the condensate system which contributed to the presence of hot condensate. The highlighted had not in fact been completed and there had been inadequate physical checking of the isolation work prior to handover for maintenance. The Permit to Work system had not highlighted potential hazards, and due to work overload was not being operated effectively.

[permit to work system inadequate, burns, isolation inadequate]

Lessons

The following recommendations were made:

1. Key isolation valves should be checked for passing.
2. All work packs were re-checked for proper system isolation before shutdown work recommenced.
3. The organisation and supervision for the shutdown were reviewed and clear requirements for detailed recording and handover of progress between shift teams were set.
4. A schedule was to be set up for a management review of the progress of the new coordination routine and for general safety auditing of the shutdown activities on the plant.
5. The lessons learnt from the incident were to be circulated to other plants undergoing shutdown, to identify Best Practice for the future.
6. Generic recommendations from other condensate related incidents were to be reinforced.

Source : CHEMICAL HAZARDS IN INDUSTRY, SEPTEMBER 1999.

Location : , GERMANY

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in a chemical plant. The incident occurred during production of toltrazuril, an ingredient used in production of a parasiticide.

It was originally thought that the explosion occurred during production of a fungicide.

Apparently a worker used potassium hydroxide instead of potassium carbonate in a reaction with 2-chloro-5-toluene and dimethyl sulphoxide.

The plant was completely destroyed.

[operator error, accidental mixing, processing, damage to equipment]

Lessons

[None Reported]

Source : HAZARDOUS CARGO BULLETIN, FEBRUARY 2000.

Location : Kalgoorie, AUSTRALIA

Injured : 0 **Dead** : 0

Abstract

A leak of sodium cyanide occurred from a tank container.

The incident occurred due to poor design and location of a pressure test nozzle, which led to the leakage of cyanide liquor from a tank container unloading liquid sodium cyanide.

The end frames of the container normally protect such nozzles but in this case the nozzle protruded over the top of the end frames. It is thought that the nozzle had been damaged when another tank container was lifted over this unit.

[spill, design inadequate]

Lessons

The owner of the tank container has subsequently redesigned the unit and all similar containers so that the pressure test nozzle does not protrude outside the body of the tank.

The company concerned has prohibited the practice of lifting containers over the top of tank containers.

1199214 April 1998

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

Ammonia was released through a small hole when a contractor, dismantling a redundant plant, cut into a pipe. The site was evacuated as a precaution.
[contractor error, demolition, evacuation, gas / vapour release]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A diesel fire occurred on a production platform as operators were filling the diesel tank for the essential generator. The operator noticed that it was taking too long to fill the diesel tank and began to check for a problem. He found that the float indicator on the diesel tank cover was reading three quarter full. He removed the level gauge to determine the exact fuel level which resulted in fuel spraying into the generator enclosure. The diesel oil contacted the generator exhaust which ignited the fuel.

The cause of this incident is related to the design of the fuel tank and filling system. The safe filling procedure relied entirely on the mechanical level gauge and the operators ability to judge when the tank was full. The design faults are as follows:

1. Inadequate level indication on the tank.
2. No high level alarm or switch.
3. No overfill protection to shut-off pump.
4. Gauge connection located inside enclosure.

[fire - consequence, material transfer, design inadequate, mechanical equipment failure]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN 154, 9-14.; U.S. CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, (<http://www.chemsafety.gov>).

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Location : Louisiana, USA**Injured :** 1 **Dead :** 1**Abstract**

A worker was killed and a contractor was seriously injured due to nitrogen asphyxiation.

On March 27, 1998, at approximately 12:15 pm, two workers at a manufacturing plant, were overcome by nitrogen gas while performing a black light inspection at an open end of a 48-inch-wide horizontal pipe. The 48-inch pipe was open because chemical-processing equipment had been shut down and opened for major maintenance. Nitrogen was being injected into the process equipment primarily to protect new catalyst in reactors from exposure to moisture. The nitrogen was also flowing through some of the piping systems connected to the reactors. The nitrogen was venting from one side of the open pipe where it had formerly been connected to an oxygen feed mixer. No warning sign was posted on the pipe opening identifying it as a confined space or warning that the pipe contained potentially hazardous nitrogen.

The two workers had placed a sheet of black plastic over the end of the pipe to provide shade to make it easier to conduct the black light test during daylight.

While working just outside the pipe opening and inside of the black plastic sheet, the two workers were overcome by nitrogen. One worker died from asphyxiation. The other worker survived but was severely injured.

[fatality, entry into confined space, safety procedures inadequate, injury]

Lessons

Nitrogen is an odourless, tasteless, and invisible gas that can cause asphyxiation at high concentrations. When used in confined spaces, nitrogen is especially hazardous because it cannot be detected by human senses but can cause injury or death within minutes by displacing the oxygen that is required to sustain life.

The following recommendations were made:

1. Post signs containing the warning "Danger, Confined Space: Do Not Enter Without Authorization" or similar wording at potential entryways when tanks, vessels, pipes, or other similar chemical industry equipment are opened.
2. When nitrogen is added to a confined space, post an additional sign that warns personnel of the potential nitrogen hazard.
3. Ensure that the plant safety program addresses the control of hazards created by erecting temporary enclosures around equipment that may trap a dangerous atmosphere in the enclosure if the equipment leaks or vents hazardous material.

Source : ICHEME

Location : , SINGAPORE

Injured : 0 Dead : 0

Abstract

An explosion occurred in a let down tank during installation work of a disperser and platform. Apparently, contractors were carrying out welding work to secure the position of the let down tank. After the intended welds an explosion occurred inside the tank, blowing off the manway cover and blowing a hole in the roof. There were no injuries.

An investigation found that:

1. The let down tank had been cleaned but not gas freed.
2. No welding work was anticipated by the supervising engineer and a hot works permit was not requested by the contractor.

[cleaning procedure incorrect, permit to work system inadequate, contractor error]

Lessons

[None Reported]

Source : ICHEME

Location : , FRANCE

Injured : 1 Dead : 0

Abstract

An contractor operator fell into the water between a ship and a jetty.

The accident occurred when the seaman on board the ship released the tanker hose. It appears that the hose knocked the operator off the jetty into the water. Fortunately the location of a nearby ladder allowed the operator to climb back to safety. He suffered extensive bruising.

The cargo loading arm was too short (outside its operating envelope) for this particular ship and therefore the transfer operation had to be undertaken using a hose.

The incident happened during darkness and the operator was not wearing a life jacket.

The immediate cause of the accident was the unsafe way in which the hose was released from the ship to the shore.

The basic causes were :

1. An inadequate loading arm which was not designed with an operating envelope which takes into account all the various factors including the freeboard of the largest and smallest tankers.
2. No risk assessment (task analysis) prior to using a hose instead of the loading arm.
3. A potential contributory factor was that the jetty operator was not wearing a life jacket since he could have easily drowned.

[fall, marine transport, operator error, design or procedure error]

Lessons

[None Reported]

11751January 1998

Source : BBC NEWS, SEPTEMBER 8, 1999, (<http://www.bbc.co.uk>).

Location : , UK

Injured : 0 Dead : 2

Abstract

Two workers fell eight floors, 100 ft, from a building after cutting a hole most of the way round themselves, with out wearing safety harnesses, and had no way of saving themselves.

A demolition firm was fined £200,000 (1999).

[fall, fatality, safety procedures inadequate, management system inadequate, demolition, tools & access equipment]

Lessons

[None Reported]

104151998

Source : LOSS PREVENTION BULLETIN, 140, 23.; CNN.COM, U.S. NEWS, 15 FEBRUARY 1998.

Location :

Injured : 150 Dead : 0

Abstract

A rail transportation incident. More than 150 people suffered burns, 120 critically, after huge flames swept through a crowd of people following the collision of two petroleum tanker trains.

Most of the people were soaked in petrol because, prior to the explosion, they were carrying buckets laden with petrol to and from their houses. Some witnesses suggested the source of ignition was a cigarette from one of the crowd.

The cause of the collision of the two trains is not immediately clear.

[fire - consequence, gasoline]

Lessons

[None Reported]

123781998

Source : CHEMICAL HAZARDS IN INDUSTRY, MARCH 2000.; RESPONSIBLE CARE REPORTS, DEC 1999, (17), 5.

Location : , UK

Injured : 0 Dead : 1

Abstract

An electrical explosion occurred at a chemical manufacturing plant killing a power and control artificer.

The conclusions from the report stated that it is essential to have up to date maintenance procedures and electrical safety rules that do include the appropriate job assessment.

[maintenance inadequate, management system inadequate, burns, fatality]

Lessons

[None Reported]

120811998

Source : CHEMICAL HAZARDS IN INDUSRY, OCTOBER 1999.; PLASTIC NEWS, 23 JUL, 1999.

Location : , USA

Injured : 0 **Dead** : 1

Abstract

A worker was killed when he was crushed in an injection moulding machine at a plastics plant. The company was fined \$7600 (1999).
[fatality, design or procedure error, normal operations, safety procedures inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A lube oil spillage occurred during the demolition of a redundant road tanker filling gantry due to inadequate isolation of the pipework. The redundant road tanker filling gantry consisted of numerous horizontally run overhead pipes that branched off from existing operational pipes going to other filling stations.

The demolition work was controlled under a permit-to-work that clearly required positive isolation of each filling line.

The permit considered the line in question to be positively isolated by a blind. Unfortunately due to the congestion of lines in the area, the line was mistakenly identified with an adjacent pipe which was fitted with a blind.

The fact that a blind had not been fitted or the ball valve was not in its closed position was not discovered until the main filling line was used again to the existing operational filling station.

The slop header could not cope with the flow of oil from the hose with the result that the tundishes overflowed onto the rail tracks and road. Approximately 8,500 litres of oil was

recovered by means of a vacuum truck or from the oily water sewer.

A further spillage occurred the following day. In spite of checking the position of the handles on the ball valves, it had not been identified or considered for the handles to be 90 degrees away from their normal position and no blinds had been fitted to the lines. The valve handles had been

modified sometime ago to enable a mechanical locking device to be fitted. Not only had the handles been modified, washers had been fitted which obscured the true position of the ports in

the valve itself. There was no way of determining whether the valve was open or closed and not all the valves had been modified. An inconsistent arrangement which was prone to human error. Approximately 4,500 litres was recovered from the second spillage under level control.

The immediate causes of the spillage was failure to positively isolate the pipes through shut and locked ball valves and the installation of blinds.

The basic causes were the failure to properly document previous modifications of the valve handles and failure to follow the correct isolation practices for demolition work before issuing work permits.

A contributory cause was a failure to carry out regular monitoring of the work permit system for this type of activity.

[isolation inadequate, design or procedure error]

Lessons

[None Reported]

Source : CHEMICAL HAZARDS IN INDUSTRY, JUNE 2000,; HEALTH & SAFETY BULLETIN, NOVEMBER 1998, (273); 2.

Location : , UK

Injured : 2 **Dead** : 0

Abstract

Two workers were exposed to plutonium particles at a laboratory during dismantling of pipework from a redundant glove box. Two companies involved in the incident were fined, one £14,000 (1998) and the other £4,000 (1998).

[laboratory work, contamination, safety procedures inadequate, injury]

Lessons

[None Reported]

Source : LOSS CONTROL NEWSLETTER, 1997.

Location : , TAIWAN

Injured : 2 **Dead :** 3

Abstract

An explosion and fire destroyed an LPG tank and nearby gas oil and fuel oil pipelines. Cigarettes and a bottle of wine were found at the site.
[storage tanks, fire - consequence, fatality]

Lessons

[None Reported]

Source : ICHEME

Location : , FRANCE

Injured : 1 Dead : 0

Abstract

During the removal of one of two furnace tube header plugs in preparation for the mechanical decoking of a furnace, the plug ejected under residual nitrogen pressure and struck the contractor's face. The contractor required hospital treatment.

The furnace contains a radiation section consisting of four passes of vertical 4-inch diameter hairpin tubes. Each pass consists of 31 tubes, with a height of 20 meters arranged with plug headers at the top returns and "U" bends at the bottom. Nitrogen at 12 bar pressure through a three quarter inch hose was connected to each tube pass to push the gas oil out of the furnace to slops. This was not effective (unknown at the time) with the result that nitrogen was trapped in the top of the tube(s) between legs of gas oil. Pressure of the nitrogen in the top of the tubes being equivalent to the hydraulic pressure/height of gas oil in the tube legs. The strongback (clamp) holding the plug was removed after which a whistling sound was heard and the plug shot out of the header striking the contractor's head.

[preparation for maintenance, maintenance, furnace, design inadequate, injury]

Lessons

The following recommendations were made:

1. Preparation of plant for maintenance procedures should be subject of a hazard/job safety analysis.
 2. A nitrogen purge may not clear lines of liquids and trap hidden pressure.
 3. Always have a second safeguard when breaking into process systems and communicate this requirement on the work permit.
-

1120121 October 1997

Source : ICHEME

Location : , USA

Injured : 3 Dead : 0

Abstract

H₂S (hydrogen sulphide) was released while a relief valve was being replaced. The pipe fitters working on the valve were wearing air supplied breathing apparatus and were not injured. However, other nearby workers were exposed to H₂S, three of which were hospitalised overnight.

The incident occurred during schedule maintenance on a hydrodesulphurization and regeneration unit. Eight relief valves had been removed from various parts of the units and two had already been replaced prior to the incident. Battery limit blinds had been installed on the majority of key lines. As a result, turnaround personnel believed they could cover all maintenance work on a single work permit. Therefore, no specific work permits were prepared authorising the replacement of the relief valves. The relief valves were located in the line going into the 24 inch blowdown header to flare. The 24 inch blowdown valve had been open throughout the turnaround. The 8 inch valve in the line to the blowdown header was also open since it was inoperable and could not be closed. On the 21 October 1997, two contractor pipe fitters had removed the 6 inch and 8 inch blind flanges and began to replace the west side safety relief valve. During this sequence of work, H₂S was released.

[gas / vapour release, flare line, flare system, blind/spade/slip plate, safety relief valve, isolation inadequate, maintenance procedure error, injury]

Lessons

The following recommendations were made:

1. A hazard analysis must be carried out before commencing any work involving opening a flare line.
 2. Work on a live flare system requires special dispensation from a senior manager.
 3. A detailed procedure covering isolation, draining and purging requirements must be prepared prior to maintenance work.
 4. Detailed safety instructions for the opening of any pipeline must be included in the work permit.
-

Source : ICHEME**Location :** ,**Injured :** 1 **Dead :** 0

Abstract

An ammonia tank was taken out of service in the July for its scheduled 3-year inspection and hydraulic pressure test. At that time, the opportunity was taken to replace valves A and B (part of a block and bleed system) on the steaming-out line to the tank. On August 13, during the first discharge of ammonia from a truck, an operator discovered valve B was leaking. He identified this valve as type suitable for steam but unsuitable for ammonia service. As a precautionary measure the tank was taken out of service with the ammonia depressured through a water drum to absorb the gas. At 09:00 hrs. on September 11, three contractors (including the supervisor) arrived to get their work permit signed and issued. The work to replace valves A and B involved the dismantling of the small diameter pipe that was fixed to the ammonia tank at flange 2. The Operator (Issuing Authority for the work permit) wrote on the permit form that the tank still contained ammonia vapours. He also informed the contractors that it would be necessary for them to wear breathing apparatus for all the work associated with the piping/valves to the tank. He did not, however, write this requirement on the permit form. At 14:00 hours, two of the three contractors (excluding the supervisor who was busy on another job) returned to disconnect flange 1. The contractor working on the flange wore breathing apparatus while the other stood by the breathing air gas bottle. While working on flange 2, the contractor's supervisor returned, put on breathing apparatus and assisted his colleague in removal of the pipe. The contractor's supervisor then decided to remove the leaded joint and clean it by scraping. At that moment he decided to remove his breathing apparatus (presumably to see more clearly) because he considered the atmosphere to be safe. As he bent down near the flange opening he was exposed to ammonia vapour. He was driven to the first aid station by one of his colleagues and transferred to hospital.

[unloading, gas / vapour release, safety procedures inadequate, permit to work system inadequate, asphyxiation]

Lessons

The issue of a work permit which, after all, is only a piece of paper does not by itself make a maintenance job safe. This is dependent upon the care and attention given by the Issuing Authority in the removal of known hazards and making certain that those performing the work are made fully knowledgeable of any remaining potential hazards and precautionary measures to be followed.

During any maintenance/repair work, replaced equipment or parts thereof must have exactly the same specification unless the modification is authorized under the Management of Change procedure.

Those who issue permits-to-work must be formally trained and certified as a competent Issuing Authority for a specific process area/unit.

Contractor's supervisors who act as a Performing Authority by accepting permits and the conditions for the work must be trained in this responsibility.

Source : ICHEME

Location : , FRANCE

Injured : 1 Dead : 0

Abstract

A contractor received injuries to his thumb when a pump started automatically while he was greasing the coupling.

A maintenance contractor requested the chief operator to isolate 4 pumps in the benzene pump house, to enable maintenance the following morning. Of the four pumps, pump 4 is used to pump slops from an oil pit on stop-start operation controlled by high and low level switches in the pit. In order to have the pump out facility in operation overnight, the chief operator decided not to isolate No.4 that night, but to wait until the following morning. The other three pumps were isolated and electrical isolation certificates completed. The isolation certificate numbers were not, however, indicated on the work permits, so it was not clear which pumps had been isolated. Before the work began in the morning, the chief operator gave authorization to commence work without specifically informing the contractor that No.4 had not been isolated. He asked the contractor to begin work on pump No.2 first so that No.4 could be isolated in the meantime. When the contractor came to work on No.4, he checked its isolation status by operating the stop/go button as indicated on the permit. Since it did not start, he assumed that isolation had been carried out and commenced work. However, the pump is remotely controlled by the pit level so the stop/start button is not active when the pump is in auto mode. During the maintenance operation, the pit filled and the level switch started the pump, causing injury to the contractor's thumb. He received first aid at the refinery medical center and further treatment at the hospital.

The investigation made the following observations:

The chief operator should not have given authorization to proceed before the electrical isolation of the pump had been carried out (i.e. the permit for No.4 should have been withheld) The isolation certificate numbers were not noted on the permits so it was not possible to cross check which pumps had been isolated. There was a failure to follow the isolation procedures - it is the responsibility of the issuing authority (operator) to confirm that the pump has been isolated (prior to issuing the permit).

The following corrective actions were taken:

1. Organise awareness meetings regarding the safety regulations particularly related to the permit-to-work system.
2. Further discussions will be held on the use of supplementary padlocks by refinery maintenance/contractor staff for electrical and mechanical isolations.

[isolation inadequate, injury]

Lessons

The following recommendations were made:

Electrical isolation (lockout/tagout of the isolating device in its isolated position or equally secure method) must be completed with full written details and item serial numbers on the isolation certificate and/or work permit prior to hand-over to maintenance.

For a pump motor equipped with an automatic start, it is not possible to prove the integrity of the isolation by attempting to start the electric motor from the local start button.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

During a routine switching over of coke pots at the bottom of a combination tower, hot vacuum tower bottoms oil (VTB) was released to atmosphere and auto-ignited. The resultant fire caused plant damage of \$180,000 (1997) and loss of production of \$410,000 (1997). It was very fortunate there were no injuries to personnel since operators were working above the coke pots at the time of the incident.

At 1420 hours, the fractionator operator was instructed to switch over the coke pots. These pots are designed to remove coke fines from the bottom of the combination tower on the outlet to the suction side of pump. Only one pot is in service at any one time, the other being on standby. They are normally switched over every Thursday or as necessary. The operation involved taking drain pot B out of service and replacing it with pot A. Before the contents of the pot can be drained, the pot has to be cooled with 32 degrees C/90 degrees F purge oil from 321 degrees C/610 degrees F to 121 degrees C/250 degrees F. At 1450 hours, the fractionator operator was advised by radio from the control board operator that the temperature of the pot was 232 degrees C/450 degrees F. There is no local temperature indicator at the pots, only a temperature transmitter back to the control room.

At 1500 hours, a coke drum change over commenced as this was already planned and also requires the assistance of the fractionator operator. As soon as the fractionator operator had completed the tasks associated with the coke drum change, around 1510 hours, he proceeded to drain the coke pot. The flow from the drain appeared excessive and as he was about to close the drain valve, the fire erupted.

The incident occurred on the last day of the work shift and the last day before a major holiday. It was unusual to have a major coke drum switch at the same time as a coke pot switch. The coke drum switch requires the efforts of three operators including the fractionator operator. The coke pot switch requires the efforts of the fractionator operator plus another operator. Both tasks are coordinated through the control board operator under the supervision of the chief operator. The fractionator operator had completed the switchover from coke pot B to A including alignment for purge oil cool down at 1430 hours without the usual assistance of a second operator. He returned again to the operation after he had finished his tasks associated with the coke drum switch. There is conflicting evidence as to whether the fractionator operator, in fact, had permission to drain the coke pot from the control room (radio communication). Coke fines present in the system tend to make it difficult to operate the valves which are often plugged.

Evidence suggests that the four-inch suction valve from pot B to pump was a quarter open (2-3 rounds) and that the purge oil valve was also open when the fire occurred. The pot had been pressured up and the operator had taken his wrench to #bang# the drain valve in order to clear the system and get flow started. Once the drain broke free, hot oil splashed out of the containment pit.

[operational activities, valve, design inadequate, autoignition, fire - consequence, spill]

Lessons

Effective controls including periodic task observations must be implemented where there is any possibility of oil being released to atmosphere above its auto-ignition temperature.

Source : HAZARDOUS CARGO BULLETIN, 1997, AUG. REUTER.

Location : Texas, USA

Injured : 0 **Dead** : 2

Abstract

A marine transportation incident. Two crew were found dead in a partially filled tank on a chemical ship, protective clothing inadequate.
[safety procedures inadequate, fatality]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Approximately 1000 litres of intermediate containing xylene was spilt when an operator failed to check a connection from a pump. The spillage was contained and covered with foam. There were no environmental consequences.

[operator error, spill, near miss]

Lessons

[None Reported]

Source : ICHEME

Location : , SINGAPORE

Injured : 1 Dead : 0

Abstract

A refinery reactor incident. An inspector was working from a rope ladder. He slipped from the rope ladder, falling 4-5 m to the stainless steel bottom head. The refinery's emergency medical team arrived in about 10 minutes, by which time the man had lost quite a lot of blood. (The injured man had a two and a half inch cut behind his left temple.) The emergency team applied first aid to slow the bleeding. The man showed clear signs of dizziness. They decided that the local Civil Defence Force (CDF) was required to remove the injured man from the reactor, as they are specifically trained to rescue victims. With the help of CDF it was 2 hours before he was out of the reactor.

The whole incident occurred in the middle of the night, which possibly added to the delays which were encountered. At the hospital it was determined that the injured man had a hairline fracture of the skull and a severe concussion. Additionally, he had a severely broken thumb, a somewhat smashed foot, various bruises, and scrapes and cuts. He had not been wearing a safety harness for this inspection, which was being carried out from a rope ladder. A standby man had been in attendance, and was the one who summoned help.

It is now mandatory that those working at height from non-rigid, non-railed platforms or ladders are attached to a proper safety harness, secured tight with a fall arrestor to an appropriate anchor point.

[safety procedures inadequate, reactors and reaction equipment, injury]

Lessons

The following recommendations were made:

1. People working at height on non-rigid non handrailed platform or ladders must wear a safety harness with a fall arrestor attached to a secure anchor point.
 2. It is essential to have the correct rescue equipment available on site for foreseeable incidents.
 3. It is necessary to train rescue teams in the difficult process of removing injured people through vessel manways.
-

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

An incident at a coatings plant. A fitter was working on pipework to remove a blockage from a high speed disperser on the middle floor of a production building. The fitter told the supervisor and an operator not to use the machine. However, whilst he was on a break, a second operator on the top floor started to charge the disperser and 190 litres of xylene flowed out through open pipework. The site was evacuated whilst the spill was cleared.

[evacuation, operator error, permit to work system inadequate, maintenance]

Lessons

Isolation procedures and Work Authorisation notes to be developed

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

A contractor was removing a scaffold in the boiler house collapsed from heat stress and fell whilst working above an access well in the turbine room. The temperature was 42 degrees C (107 degrees F). The contractor fell a distance of approximately 5 m, sustaining serious facial injuries.

The incident occurred when at 7:45 am on April 3 ,1997, three contract scaffolders signed on in the boiler house control room to remove scaffolding, work that had begun the day before. The scaffold had been erected around the whole of the perimeter of the turbine floor in order to safely install cabling for the evacuation alarm system and it was in two layers. The top layer had been removed the day before. The lower layer crossed a brick wall well that contained steam lines to the desuperheater. The well was covered with non-bearing beams made up of lagging/insulation materials. The injured scaffolder had been working for 45 minutes removing scaffold directly above a 125 psi lagged steam line when he fell into the well section and onto the non-load bearing beams. The structure collapsed with a loud noise, and he fell a further 3 m to the floor in an avalanche of debris.

The investigating team felt that not enough consideration had been given to the special hazards associated with this job, especially the high temperature of 42 degrees C encountered, and the height. Hazards associated with this work had been considered and recorded as low risk. The completed risk assessment form notes that some consideration had been given to the prevailing heat and noise, and a verbal briefing had been given by the chargehand reminding those involved to take a "break when necessary." The investigating team concluded from the documents that the hazards were not picked up because there was very little, if any, communication between those doing the job and the local operations personnel. The work environment and heat stress contributed significantly, and the investigating team felt that there is probably a low level of understanding of the consequences of each. The potential for this incident to have been a fatality is obvious. The investigating team checked for the possible presence of amine in the atmosphere but concluded this was not possible.

The following action was taken:

1. Review the risk assessment process to ensure the appropriate knowledgeable people are involved at all levels.
2. Communicate the effects of heat stress to all staff.
3. Introduce the use of fall arresting equipment and support, with appropriate training, for all unprotected work areas above 2 m.
4. Improve the quality of tool box talks by turning every significant incident into a briefing to help communicate, and measure that this is done by signed returns and audits.
5. Provide clearer guidance for what an investigation should achieve, and how quickly.
6. Any non-load bearing area should be clearly marked so that it is not missed.

[scaffolding, fall, people, maintenance, safety procedures inadequate, management system inadequate, design or procedure error, injury]

Lessons

1. Always involve people familiar with the working area when assessing risks.
2. Assess the potential for heat stress during maintenance work.
3. Use fall arrestors for all unprotected tasks at heights above 2 m.
4. Ensure all information on the work permit is communicated to and fully understood by those performing the job.

Source : ICHEME**Location :** , UK**Injured :** 2 **Dead :** 0**Abstract**

A company technician and an instrument/electrical contractor were preparing to install a local capillary sealed differential pressure indicator to a catalyst filter. The men had been issued with a permit to work which requires full personal protection equipment and self contained breathing apparatus to be worn. On arriving at the location a nitrogen hose, connected to the catalyst system, was restricting access to the workplace.

To improve access, the hose, previously used to purge the filter from the system and valve isolated at either extremity, was disconnected. This operation released a small quantity of the filter which created a cloud of 10 to 12 inch length to which both men were exposed. At the time of this activity neither of the men had their breathing mask fitted since they were not aware that the disconnection constituted a break of containment for which breathing apparatus had to be worn.

Immediately after this event the contractor, who had been closer to the release than the technician, went to the control room for treatment (water wash and application of catalyst anti-dote gel), after which he received further treatment at the Medical Centre.

The technician was not aware that he had been affected until about an hour later, after this delay he too washed and applied anti-dote in the control room and went for treatment at the Medical Centre.

Both men were taken to hospital where they were kept overnight for observation. They were released in the morning and returned to work that day.

[maintenance, burns, safety procedures inadequate, gas / vapour release, injury]

Lessons

Recommendations following the accident included the following:

Reinforce to Production Teams that connecting and disconnecting of hoses is breaking containment with associated personal protection equipment /control of work requirements.

Operating Instructions to be updated in detail. Infrequent operations require a greater level of detail.

All personnel should be made aware that all injuries, no matter how apparently trivial, should be reported to the Medical Centre for immediate treatment to avoid a more serious condition developing.

Source : LOSS PREVENTION BULLETIN, 136, 26.

Location : ,

Injured : 1 **Dead :** 0

Abstract

A company has been fined and ordered to pay costs totalling almost £4,000 (1997) after a barrel containing hazardous fumes exploded and injured an employee. The incident occurred when an employee was removing the tops of barrels with a flame cutter. The employee had removed the tops of three barrels, which had once contained a polyester resin, with no problems. But when he applied the torch to a fourth, which still contained styrene vapour, there was a loud bang. The top of the 205-litre drum, measuring about two feet in diameter and weighing about 2.7 kilos, was ejected and flew past the employee, landing 70 m away on top of a house. The employee suffered minor burns but was wearing suitable protective clothing.

[explosion, drums, safety procedures inadequate, hot work, injury]

Lessons

[None Reported]

Source : ICHEME

Location : , FRANCE

Injured : 2 Dead : 0

Abstract

A fire broke out at gas oil hydrodesulfurization unit. The fire was caused by a leak of gas oil and gaseous products from the flange of a temperature control valve. The fire, restricted to the reactor section, was put out within 35 minutes by the refinery fire brigade. Two operators were injured while manoeuvring an extinguisher, but did not incur a lost time accident. The incident occurred following gasoil feed upset in the late morning, heavy rain in the afternoon and a hailstorm at about 22:30 hrs. The fire resulted in damage to control valves, piping, cables and associated heat exchangers.

[flange, valve, refining, rain, design inadequate, inspection inadequate, fire - consequence, flange failure, injury]

Lessons

Wafer type valves which, by design, are installed by "insertion" are unreliable and liable to leak.

All wafer valves to be identified and a risk assessment carried out to review their continued suitability in service.

Critical flanges need to be identified and regularly inspected, following an established procedure.

The investigation team concluded that the incident was caused by the following factors:

1. Inherent design weakness of the wafer type valves.
 2. The poor condition of the flanges on the valves and piping.
 3. Thermal shock imposed on the valves due to severe weather conditions (rain and hailstorm) and process upset earlier on in the day.
-

Source : LOSS PREVENTION BULLETIN, 136, 25.

Location : ,

Injured : 1 **Dead :** 0

Abstract

Two companies involved in a joint venture digging tunnels for the Jubilee line underground extension were fined £5,000 (1997) each after an accident which injured a carpenter. The carpenter fell 5.5 m onto his head while water-proofing a roof on an extension to the site office. No guard rails had been provided on this section of the roof. The carpenter suffered serious head injuries and numerous fractures. The two civil engineering companies pleaded guilty to the summonses under the Construction (Working Places) Regulations.

[safety procedures inadequate, fall, injury]

Lessons

[None Reported]

112031997

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

An old power transformer needed to be replaced with a new more powerful one. Electricians isolated the old one to remove it from its location. They put the circuit breakers into the off position on the 6600 volt inlet to the transformer and the ones on the 415 volts outlet which supplies the wharf facilities. They then started the emergency diesel generator to supply power to the users. Since the outlet of this emergency generator is connected to the outlet of the transformer, these power cables were alive (energized). When an electrician separated the connecting cables from the transformer body, a short circuit happened and an electric spark occurred.

One electrician was exposed to spark light and his eyes were irritated. He was hospitalised for a few hours.

[modification, transformer, circuit breaker, competency lacking, short circuit, testing inadequate, injury]

Lessons

When working on electrical systems and equipment even it is electrically isolated from surrounding, all connections must be measured with proper instruments.

Source : ICHEME

Location : ,

Injured : 2 Dead : 0

Abstract

An accident occurred on a platform during a lifting operation of three and a half inch drill pipe from the moving pipe deck to main deck which resulted in 2 people being injured.

The drill pipe was being lifted in bundles of 15 (11 joints per bundle being the recommended number). The injured persons had positioned themselves between the load and a wire line power pack unit, in addition there was a hanger module lying on the deck directly behind them. As the lift commenced the drill pipe was drawn together and rolled away from the persons involved towards the crane. Once the slack had been taken up in the slings and the load had cleared the dunnage the bundle swung away from the crane back towards the persons involved catching them both off guard. This resulted in one injuring his knee trying to avoid the load with the other being crushed between the bundle and the power pack unit. There were no protective posts in use to protect the persons from the swinging load.

[operational activities, offshore, lifting equipment, inadequate guarding, safety procedures inadequate, injury]

Lessons

The following recommendations were made:

1. Awareness of the risks involved when handling bundled pipe.
 2. The importance of the boom tip position in relation to the center of the load.
 3. Positioning of people during lifting operations.
 4. Ensuring that personnel involved in lifting operations are fully aware of and use the correct procedures.
 5. The use of protective posts for this type of lifting operation.
 6. The maximum recommended number of joints per bundle should not be exceeded.
-

112021997

Source : ICHEME

Location : ,

Injured : 2 Dead : 0

Abstract

An electrician was using a metallic mirror to inspect the back side of a breaker connection in a 480 volt motor control centre when a metal part of the mirror came into contact with an energised portion of the breaker, causing a large electrical arc.

Two employees received second degree burns from the flash over. Two of the three alkylation units on the plant shut down from the power surge and Crude/Vac suffered reduced feed rates for a short period.

The immediate cause of this incident was the use of metallic tools to inspect hot electrical equipment.

[inspection, circuit breaker, arcing, operator error, injury]

Lessons

Use only non-conductive tools and proper safe work practices when required to work on live (hot) electrical equipment.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

As is common on many compressors, the flash gas compressor has a seal oil reservoir venting to the miscellaneous vents system, and a lube oil reservoir venting to atmosphere. This incident occurred when back pressure in the vent header caused an increase of pressure in the seal oil reservoir, leading to migration from the seal oil system to the lube oil system. The gas entrained in this oil then escaped to atmosphere from the lube oil reservoir vent. The restriction in the vent header arose due to an incorrectly applied isolation on the drains system, which had been put into place to allow change out of a submersible drains caisson pump. Drain lines from various locations on the platform pass through sand pots, or seal pots, before entering the caisson. These pots vent to the miscellaneous vents header. Isolations were applied on the outlet of the pots, but not on the inlets or vent lines. As a result, water entering the drains backed up into the vent system, leading to the oil contamination incident described above.

[processing, compressor, vent, backflow, isolation inadequate, vent blocked, gas / vapour release]

Lessons

The availability of an unrestricted vent is critical to compressor lube/seal oil systems.

Source : CHEMICAL HAZARDS IN INDUSTRY, 1997, NOV.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A process needed to be altered to make different isomer of a material, necessitating recalibration of two measuring vessels. The first vessel was calibrated successfully, but there was an explosion in the second vessel with three workers inhaling resulting fumes and two operators experiencing chemical splashing. The explosion resulted from the operators wrongly discharging the first vessel during calibration of the second one.

[operator error]

Lessons

Consideration of the process kinetics and thermodynamics, labelling of equipment etc., operator communication and training, and general procedures require careful consideration.

Source : LOSS PREVENTION BULLETIN, 134, 25.

Location : , HONG KONG

Injured : 2 **Dead** : 0

Abstract

A cargo of expandable polystyrene exploded. Subsequent investigations determined that the cargo contained expandable polystyrene beads, which evolve flammable pentane vapour.

There was no declaration so none of the parties involved was aware of the dangers.

[explosion, labelling incorrect]

Lessons

[None Reported]

Source : CHEMICAL HAZARDS IN INDUSTRY, 1997, OCT.

Location :

Injured : 0 Dead : 1

Abstract

A maintenance worker died from severe head injuries after falling through a skylight.

The employee was not assigned to be working on the roof and was alone at the time of the incident.

[fatality, safety procedures inadequate, fall]

Lessons

[None Reported]

111961997

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

An incident involving entry into a glycol contactor vessel. The vessel had been purged of fumes with an inert gas and then ventilated before entry. A worker, on entering, removed a mist screen in the lower part of the vessel and lowered himself down into the space below the mist screen level. He immediately felt disorientated but was able to climb up, and out of, the vessel. Subsequent investigation showed that there was only a 3.6% level of oxygen in the atmosphere of this compartment, some 4.4% less than the minimum oxygen level that a person can survive within.

[entry into confined space, reaction vessel, atmosphere not tested, asphyxiation, glycol]

Lessons

This incident highlights the need to be aware of the hazards associated with confined space entry.

Source : ICHEME

Location : , TURKEY

Injured : 1 Dead : 0

Abstract

A shift supervisor suffered a broken rib as a result of the fall sustained when he became unconscious following exposure to hydrogen sulphide (H₂S) during the draining of a level controller. Process operators noticed an abnormally low hydrocarbon level in the overhead accumulator drum on a kerosene stripper tower. Since it was not possible from the control room to increase the level, the shift supervisor on duty decided to check the level controller on site. With a field operator to assist him, the shift supervisor closed the two 2-inch block valves on the level control system isolating it from the drum. The field operator then unscrewed the drain plug of the level controller to clean the level buoy. Gas was released containing approximately 3.6-5.0% H₂S; and the shift supervisor who was kneeling down, checking the level transmitter nearby, immediately felt unwell. It was suspected that one or the other of the isolation valves was passing. The supervisor then directed the field operator to close the drain and in the process of moving away to obtain fresh air, collapsed on the platform. Within a minute he recovered sufficiently to return to the control room. The immediate cause of the accident was the failure to wear respiratory protection where there was a potential exposure to H₂S. The basic cause was due to failure to follow safety rules - all H₂S zones are clearly marked with warning signs and yellow paint.

[level meter/control, asphyxiation, safety procedures inadequate]

Lessons

The following recommendations were made:

1. A permit-to-work must be issued when dealing with leaks or breaking containment of plant/equipment that has contained H₂S.
2. The permit-to-work must stipulate all the necessary precautionary measures including the wearing of positive pressure self-contained apparatus or air-line masks.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

During the removal of redundant piping as part of a demolition program, a contractor cut into a live propane line. The system was isolated immediately. The contractor had been issued with a general hot work permit to demolish piping at a molecular sieve treater by cutting with a band saw. Two cuts had been completed on two separate lines and cutting had commenced on a third when propane began to escape from the pipe. A safety review had been held with the contractor on the safety procedures to be followed. This included the marking with orange and blue paint those pipes that may be removed. The line in question was not marked for removal. Subsequent investigations showed that the refinery's safe work practices for issuing the permit and the requirements for lock out/tag out had not been followed, specifically:

1. Safe work practices for isolation including lock out/tag out were not followed by the operator or the contractor.
2. Procedures agreed to in the contractor safety meeting had not been followed.
3. The agreed procedure between the contractor and operator had not been followed.

[contractor error, safety procedures inadequate, spill]

Lessons

A number of immediate actions were taken including:

1. Ensuring that employees have sufficient knowledge to ensure compliance with the refinery's safe practices.
2. Tightening job safety analysis and procedures prior to issuance of permits.
3. Weekly meetings between the contractor and operations with special focus on planned job tasks and procedures to be followed were re-established.

In addition the removal of any redundant piping requires:

1. Careful planning.
 2. Preparations, including specific task written procedures.
 3. Stringent work permit control.
 4. Good communication arrangements between the parties involved.
 5. Site visits with clear identification of the piping to be removed.
-

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

During a routine operation to sterilise a carbon filtration vessel, a Shift Technician closed a keystone butterfly valve on the 4 inch vent line of the vessel as a slug of steam/water/air discharged from the line. The vent line moved violently as his hand was on the valve handle and the locking lever struck the side of the vessel causing pinching motion. Such was the force of this movement that the top 2 cm of his ring finger was amputated.

[cleaning, reaction vessel, design inadequate, injury]

Lessons

The vent line should be secured to the adjacent 8 inch drain line with a pipe clamp to prevent movement in this process.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Approximately 8 tonnes of monomer blend was released from a storage tank into a polymerisation tank.

The liquid was contained in a bounded area and quickly covered with foam, neutralised and sent to the sump tank. There was no liquid release and no injuries or damage to the plant.

The incident occurred when two contractors were working in the area and due to a mistake, they removed the bottom valve of a full storage tank, instead of the empty storage tank beside the full tank causing the release.

[storage tanks, spill, contractor error, maintenance]

Lessons

[None Reported]

Source : CHEMICAL HAZARDS IN INDUSTRY, 1997, SEP.

Location : Ohio, USA

Injured : 0 Dead : 1

Abstract

A worker died whilst painting an auger conveyor system. The worker was standing on a ladder wearing a safety harness with a lanyard attached. At some point the lanyard got caught in the machinery and pulled the worker into the auger. The machine was operational while maintenance was being carried out. [safety procedures inadequate, fatality]

Lessons

[None Reported]

Source : ICHEME

Location : , SWEDEN

Injured : 0 Dead : 0

Abstract

A dangerous occurrence at a coatings plant.

An operator was removing a plug that was attached to a ball valve, in order to decant water from a toluene storage tank. The operation was being carried out at night in a poorly lit area. The operator did not realise that he was inadvertently disassembling the valve.

The ball valve started to pass and 18 tonnes of toluene spilt into the tank bund. This was later pumped away to containers.

[maintenance, storage tanks, spill, maintenance inadequate]

Lessons

The following recommendations were made:

1. Engineering measure to change drainage system 2. implemented.
 3. Spillage procedures to be improved.
 4. Improved instruction for weekend responsible supervisors.
-

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A night shift was converting bright dope into matt dope using a mixer by adding titanium paste. When the operator went to discharge the mixer he opened the wrong valves. The dope was discharged to old pipework which at the time was being decommissioned and had an open end. Approximately 2000 kilograms of matt dope was released. The dope was approximately 73% acetone and 27% acetate.

[operator error, mixing, spill, decommissioning]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 136, 26.

Location : Essex, UK

Injured : 1 **Dead :** 0

Abstract

A company has been fined a total of £13,500 (1996) after an employee lost two fingers whilst using a power press and, in an unusual move, ordered to make a £5,000 (1996) interim compensation payment to the victim.

[safety procedures inadequate, people]

Lessons

[None Reported]

Source : NATIONAL TRANSPORTATION SAFETY BOARD, 1999, (<http://www.nts.gov>),; LOSS PREVENTION BULLETIN 155, 16-17.

Location : Murfreesboro, Tennessee, USA

Injured : 0 **Dead** : 0

Abstract

An incident occurred whilst preparing for maintenance on an 8-inch pipeline containing diesel fuel. The incident occurred during isolation and purging when approximately 84,700 gallons of diesel fuel was released due to overpressure rupture. The line section containing the leak was isolated. Fortunately the incident did not cause a fire or explosion and no one was injured.

[overpressurisation, operator error, spill, near miss, preparation for maintenance, operation inadequate]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 136, 26.

Location : ,

Injured : 1 Dead : 0

Abstract

A company has been fined £1,000 (1996) and ordered to pay £2,500 (1996) costs after a skip container being removed by a railway crane fell onto an employee, causing serious injuries.

[safety procedures inadequate, injury]

Lessons

[None Reported]

8472 03 October 1996

Source : PROCESS ENGINEERING, 1996, NOV.;; EUROPEAN CHEMICAL NEWS, 1996, OCT, 7.;; PRESS ASSOCIATION.

Location : Avonmouth, UK

Injured : 18 **Dead** : 0

Abstract

A series of explosions ripped through an epichlorohydrin storage tank when a road tanker was unloading sodium chlorite. Smoke drifted across the M4 and M5 motorways which were closed. Rail services were closed. The documentation for the tanker appeared to be incorrect.
[storage tanks, document errors]

Lessons

[None Reported]

12792September 1996

Source : CHEMICAL HAZARDS IN INDUSTRY, JUNE 2000.; SAF. MANAGE. (LONDON), NOV 1998, 27.

Location :

Injured : 1 Dead : 0

Abstract

A flash fire and explosion occurred inflicting severe burns to a painter. The incident occurred as the painter was working in an enclosed space and had been supplied with an ordinary halogen lamp. The halogen lamp ignited fumes.

The company was fined £10,000 (1998).

[fire - consequence, hot surface, safety procedures inadequate, injury]

Lessons

[None Reported]

11641September 1996

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

An explosion combined combined a number of operating problems with a badly designed plant. Purified starch was treated in a humidifier with water and hydrogen peroxide bleach. The humidifier was supposed to have been inerted, but the vessels also had explosion relief fitted. The dust explosion tore open one humidifier vessel, and caused extensive damage to the building cladding, but comparatively little other damage. Investigation showed that:

1. The vent panels were inadequately designed and required a pressure stronger than the vessel could stand to open.
2. The vent ducts were smaller than the vents and had serious obstruction to the flow.
3. The gas analyser system fitted as part of the inerting system had been out of action for at least a week and probably much longer.
4. The nitrogen generator was incapable of delivering the required volume of nitrogen at the required purity.
5. The peroxide dosing system was filled with over-strength material and did not spray it as fine droplets as intended.
6. The mechanical conveying system in the humidifier was prone to parts falling off causing powder flow problems and possibly contributing to frictional heating in the system.

[solids processing, dust explosion, starch, solids processing equipment, design inadequate]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 139, 24.; HEALTH, SAFETY AND ENVIRONMENT BULLETIN, 264, DECEMBER 1997.

Location : , UK

Injured : 0 Dead : 0

Abstract

An explosion occurred at a chemical plant after dextrine powder ignited, rupturing the steel humidifier vessel and spilling powder into the humidifier room where it caused a second explosion. One employee working nearby was knocked off his feet.

On investigation it was found that the plant's safety measures were deficient on all counts. The nitrogen inerting system was designed to keep oxygen levels in the humidifier down to 10%, but calculations showed the dextrine would ignited at 8% to 9%. The relief vent in the humidifier was bolted in place so it contained, rather than vented, the explosion and the relief duct was blocked. The company has since closed.

[safety procedures inadequate, processing]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Heater tube rupture in a high pressure hydrogenation unit. As a result of an operational upset, the helix coil in the process heater of the 1st stage of the high pressure hydrogenation unit ruptured due to a no flow situation over a prolonged period of time. This was followed by a fire. There was damage to equipment and product loss.

Operators had made adjustments to the system in an attempt to protect the catalyst. Make-up compressors were used to purge the system free of oil with fresh hydrogen.

The cause of this incident was that operating instructions' suggestion to protect the catalyst did not set out exactly how to do it, and the operators did not understand that the system was in a lock-in situation.

[fire - consequence, faulty instructions, processing]

Lessons

Operating instructions to cover emergency situations need to be clear and reflect what is actually possible. Operator training needs to go deeper than just discussing instruction

requirements; e.g., explaining the significance of situations such as no-flow, limitations of temperature indication under no-flow conditions, and the need to seek advice from more senior staff if in doubt. Overriding of trip systems must only be done with the specified level of authorisation.

Source : THE GUARDIAN, 1996, AUG, 8.; CHEMICAL HAZARDS IN INDUSTRY, SEPTEMBER 1999.

Location : , UK

Injured : 0 Dead : 2

Abstract

An explosion and fire destroyed an adhesives factory. The incident occurred whilst workers were emptying 205 litre drums containing highly flammable liquids into a 1500 litre vessel by hand. The company was fined £100,000 (1999). Three years previously, the company had begun risk assessment, but had never completed it.

[processing, fatality, material transfer, fire - consequence, safety procedures inadequate]

Lessons

The case highlights the need to comply with Management of Health and Safety at Work Regulations 1992. (Chemical Hazards In Industry, Sept 1999).

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Compressor flywheel failure. A north recycle hydrogen compressor was started after several unsuccessful attempts. Within seconds, the two cast iron flywheels disintegrated, launching missiles in all directions. It was found that the compressor had been started in a wholly unsatisfactory condition: the flywheels were cracked and the compressor cylinder was badly fouled. The cause of this incident was a failure to devise and implement appropriate mothballing measures to ensure the unit would be available to meet future production needs. In addition there had been deficient design, particularly in the design of the key-way, and the machine design long predated current design tools.

[mechanical equipment failure, standards inadequate, start-up]

Lessons

Idle process plant must be carefully preserved if it is to be safely used in the future.

Even the most familiar tasks can present unexpected hazards, especially if carried out under unusual circumstances.

Source : EUROPEAN CHEMICAL NEWS, 1996, JUL, 22,; ENDS REPORT 267, APRIL 1997.

Location : West Yorkshire, UK

Injured : 7 Dead : 0

Abstract

During routine cleaning of a storage tank prior to maintenance and inspection. The tank was used as a vent tank to relieve pressure during unloading of delivery tankers before the gases were discharged to the site's scrubbing system. The sight glasses were obscured and the process operators assumed that the tank was empty. When water was added to the tank it reacted with an estimated 3.5 tonnes of sulphur trioxide which had built up in the tank over several months. The result was a muffled bang and the release of a white cloud. The fumes filled the building and spread some 2 miles from the site. The firm was fined £13,000 (1996).

[storage tanks, gas / vapour release, operator error]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

Contractor fatality during tank construction at an LPG terminal. A contractor's fitter working on a 3 m high catwalk for the erection of a water storage tank fell head-down into the bottom of the tank. It was found that the fitter was not using/standing on a proper platform. The time was approaching the end of the working day and, instead of rearranging the catwalk (wooded plank), he chose to balance with one foot on the pointed edge of a slender angle bar, which gave way. Fatality.

[safety procedures inadequate]

Lessons

Detailed discussion with tank constructors by the project teams on how safe working platforms are to be provided is obviously necessary before the work starts, and requirements must be written into the contracts and checked on throughout the project.

Source : ICHEME

Location : ,

Injured : Dead :

Abstract

Light ends from the FCC main fractionator were being recovered using a wet gas compressor. Two casing drains from this compressor had thinned through internal corrosion. Engineered box enclosures injected with special sealant had been installed to avoid an untimely shutdown of the compressor. Within 3 weeks of the temporary repair being installed, one of the box enclosures failed releasing high pressure hydrocarbon vapours to the atmosphere. Fortunately, there was no ignition but production losses amounted to \$56,000 (£33,433 (1996)).

Inspection of the temporary enclosure device revealed that the strongback tongue had failed. The tongue (see Figure 6) is designed to hold the leak repair device in position during the sealant injection process and during operation. The tongue is a necessary part of the leak repair device since there exists an unequal axial thrust generated during the sealant injection operation. The tongue is also vital during normal operation because the unequal axial thrust remains after the sealant injection operation is completed. This is due to the physical characteristics of the sealant material that was used. The selected sealant for this application was a thermosetting type which exhibits the characteristic of very little or no shrinkage after hardening. Therefore, whatever forces are introduced into the box enclosure by the sealant injection including the enclosed piping and fittings themselves remains as long as the device is installed. These forces can be significant due to the high injection pressures typically applied during the sealant injection process. Typically, injection pressures are in the order of 1000 to 2000 psig. This pressure is exclusive of the static pressure necessary to create sealant flow through the injection gun.

Representatives of the leak repair contractor responsible for the job were brought in to assist with the investigation into the incident. Both the leak repair contractor representative and a refinery engineer performed independent reviews of the leak repair device configuration, design calculations, material selection and design conditions used. The conclusion from both parties was that the box enclosure was properly designed. The box enclosure with the enclosed flange and piping still intact were sent back to the leak repair contractor's manufacturing facility for further inspection and testing. In addition, a full review of the installation procedure used for this specific application was carried out. According to the leak repair contractor's design calculations for the tongue, an injection pressure of 1300 psig was used to calculate the generated hydraulic thrust. The allowable working load of the tongue was calculated and shown to be 1 1/2 times the hydraulic thrust thus indicating an acceptable design. However, the leak repair contractor's review of the installation procedure used for this job revealed that an injection pressure of 2500 psig was inadvertently used for this application. Given this injection pressure, the generated hydraulic thrust due to sealant injection exceeded the allowable working load of the tongue by a factor of 1.3. The leak repair contractor representative also indicated that there was a sharp transition from the box enclosure to tongue. The excessive hydraulic thrust introduced during the sealant process, the minimal shrinkage characteristic of the type of sealant selected, in combination with a stress riser due to the sharp transition between the tongue and the box enclosure most likely resulted in a fatigue failure in the transition area. This was consistent with visual observations of the failure.

[mechanical equipment failure, gas / vapour release, competency lacking, cracking, pipe, drain]

Lessons

The justification for undertaking this type of temporary repair must be weighed against the potential consequences of failure. Such justifications should be endorsed by senior management on advice from a professional mechanical engineer. When there is justification for such a repair, all aspects of the job must be carefully examined, controlled and implemented by competent personnel.

The following corrective actions were taken:

1. The Leak Repair Contractor has reviewed the injection procedures and trained their technicians to ensure their understanding of the differences in injection mechanics associated with the various types of sealant. This will ensure that the correct sealant injection pressure is applied in future.
2. The Leak Repair Contractor's Engineering Department has reviewed high stress concentrations at the enclosure to tongue transition specifying a minimum radius.
3. Other similarly designed clamps installed have been inspected to ensure that a similar failure will not occur.
4. Inspection will continue to monitor the first and second stage drain piping at 6-month intervals or until a corrosion rate is established for each stage.

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

A rigger working for subcontractors installing pipework during a plant shutdown fell from adjacent pipework whilst carrying out preparatory work. Adequate scaffolding had been provided for the job currently in progress, but during a short interruption to the job in hand, the rigger and an associate decided to carry out the additional work, using improper access and working methods.
[maintenance, fall, safety procedures inadequate]

Lessons

1. A risk assessment would have identified the possibility that riggers would move between jobs in this way, and have recommended the provision and use of safety harnesses.
 2. A permit to work system (none was in use) would have helped to ensure that appropriate precautions were observed by the contractors.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Fuel gas release causes refinery plant shut-down. A contractor erroneously opened the body of a valve which was located in the live main fuel gas line beyond the battery limit. Hydrogen-rich gas escaped, and the refinery lost its fuel gas main pressure and all units had to be shut down. This resulted in product loss. It was found that the instruction that consultation should be carried out if any valve was to be opened was ignored.

The cause of this incident was that the work order did not specify the number and location of the valves to be checked and repaired. The valves were, apparently, not tagged. In addition, the work order had not been cleared.

[labelling incorrect, operator error, refining, plant shutdown]

Lessons

Work orders must be specific in job and location description.

Source : LOSS PREVENTION BULLETIN, 136, 26.

Location : West Sussex, UK

Injured : 1 **Dead** : 0

Abstract

A company has been fined £6,000 (1996) and ordered to pay costs of £1,043 (1996), after an employee was injured when a mobile tower scaffold overturned.

The incident occurred on a railway bridge in West Sussex, in which an employee was thrown from the scaffold onto the road.

[scaffolding, safety procedures inadequate, injury]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Hydrotreater recycle hydrogen line failure at a refinery.

Localised corrosion of a FCCU (Fluid Catalytic Cracking Unit) feed hydrotreater recycle hydrogen line by-pass around a hydrogen pre-heat exchanger led to an explosion and fire. The failed part of the line had been identified by inspection as a dead leg. After investigation it was found that the mechanism of corrosion was ammonium chloride under deposit corrosion. The source of chloride has not been traced, but hydrogen from the catalytic reformer was strongly suspected. Inspection inadequate of the dead leg was identified as the cause of this incident. There was damage to equipment, material loss and product loss. [refining, fluid cracker]

Lessons

Localised corrosion mechanisms are difficult to detect with fixed point UT, and dead leg corrosion can have several different corrosion mechanisms.

8588 23 March 1996

Source : LLOYDS LIST, 1996, MAR, 25.

Location : Uttar Pradesh, INDIA

Injured : 1 **Dead** : 3

Abstract

An explosion of a tank of methane gas at an effluent treatment plant was caused by welding on the roof of the tank to repair leaks. Police have registered a case of criminal negligence against the company. Fatality.
[safety procedures inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Safety relief valve fire on residue system. A high flow rate of liquid to a blowdown knock-out drum, allied to its limited pump out facility, eventually caused the drum to overflow. A relief valve in the bottom circuit of the CDU main fractionator opened, but it failed to close as counter measures were taken. A decision was made to have personnel wearing protective clothing clamp the passing relief valve. When the screw in the bonnet of the relief valve was removed, a jet of hot residue was released and ignited. An investigation of the failed relief valve revealed a broken spring, attributed to a material defect. The spring was not from the valve's manufacturer; rather, it was a copy, manufactured by and obtained from another company. As far as could be ascertained this other company does not use tested materials or have facilities for conducting crack testing on the manufactured springs.

[flow rate too high, overflow, valve failure, testing inadequate, fire - consequence]

Lessons

It is important that quality certified materials are used for process equipment.

Manufactured springs must undergo crack testing.

Source : LOSS PREVENTION BULLETIN, 140, 24.; HEALTH AND SAFETY AT WORK, MARCH 1998.

Location : , UK

Injured : 0 Dead : 1

Abstract

A worker operating a reach truck, pulled up close to a stationary reach truck so that he could talk to his colleague. As he stood up the reach truck moved forward crushing his head between both truck's stanchions which supported the cab roof.

[road transport, safety procedures inadequate, fatality]

Lessons

[None Reported]

8679 08 January 1996

Source : SEDGWICK LOSS CONTROL NEWSLETTER, ISSUE 1, 1996.

Location : California, USA

Injured : 0 Dead : 0

Abstract

A workman severed a gas pipe causing the transmission pipeline to crack resulting in gas release.

[gas / vapour release, operator error]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

Contractors were attempting to unplug a blockage in a pump suction line in the bottom of a mix tank used in their process to convert hazardous waste material into cement kiln fuel. One of the contractors decided to enter the tank, contrary to instructions from his supervisor, in an attempt to expedite the work. He was wearing an air purifying respirator (canister mask) and protective clothing but quickly became disoriented and lost consciousness. He had been exposed to benzene. Fatality

[entry into confined space, asphyxiation, operator error]

Lessons

There was lack of sufficient appreciation for the acute toxic hazards of petroleum hydrocarbons.

There is a need to ensure that contractors effectively carry out their written safety programmes in the field.

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

Compressor cover failure at a refinery. During a pressure test of a make-up compressor, there was a pressure increase in the distance piece. This, together with an insufficient vent of the distance piece to flare, led to a build-up of pressure; and the distance piece cover was blown away. There was injury and damage to equipment. This was due to design inadequate that allowed suction pressure to atmospheric to be taken over the last ring of packing versus across the full number of packing rings, which is the normal design.

Examination of ruptured door fragments showed an undetected fault running through the material.

[testing, injury]

Lessons

The distance piece vent line should be able to vent large amounts of high pressure gas in the event of total mechanical seal failure.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An explosion occurred when hot work was being carried out on the regenerator off-gas pressure reduction chamber. The chamber had recently undergone refractory repair.

It was found that the material used to repair the chamber produced hydrogen when water was added, which caused it to expand during application. The basic cause of this incident was that the Material Safety Data Sheet (MSDS) did not indicate that flammable gases would be given off during mixing.

[near miss, faulty instructions]

Lessons

When working with refractory materials, challenge suppliers if in doubt as to the composition of the materials being used.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Catalytic poly sample cooler failure and fire. A piping coil at the water to air interface of a sample cooler, off a depropanizer reboiler in the Cat Poly Unit, failed. Hydrocarbons were released which ignited resulting in a substantial fire. The sample cooler was used only occasionally to draw samples. There was damage to equipment and material loss. It was found that aqueous corrosion of the carbon steel pipe had occurred. During normal operation, the block valves were to be in the closed position for all sample coolers; on the day of the failure, all the block valves were in the open position. This incident was caused by inadequate inspection frequency.

[inspection inadequate, fire - consequence, cooling equipment, mechanical equipment failure, processing]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

During the lifting/moving of a dock hose, the person tasked with guiding the hose through the dock structure had two of his fingers partially amputated when they were caught between the dead leg of the two-part tag line and the sheave in the load block. This accident was caused by the structural design of the dock which resulted in a very hazardous job task; the open load block design created a severely hazardous pinch point to employees/contractors. In addition there was a lack of awareness on the worker's part as to the hazard of placing a body part in a pinch point.

[operator error, design inadequate]

Lessons

There is a need to ensure that personnel are aware of the hazard of "pinch points" in machinery, lifting equipment, etc.

It is a hazardous practice to manually handle a load line while a lifting operation is in hand.

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A contractor had been carrying out the work of moving catalyst drums. Upon entering the storage area, the unloaded forklift truck collided with a lamp post and knocked it down. The operator was thrown from the vehicle; but the vehicle overturned, trapping him between the safety roof and the ground. It was found that blind spots obstructed clear vision of the lamp post in the work area. The basic cause was overconfidence with regard to repetitive, routine work, without apparent risk and insufficient awareness in attitude toward safety.

[safety procedures inadequate, fatality]

Lessons

Even trained and experienced forklift truck operators have serious accidents, most likely through complacency.

Emphasis must be placed on maintaining an AWARENESS of good safety practice.

Source : HAZARDOUS CARBO BULLETIN, JUNE 2000.

Location : Ohio, USA

Injured : 0 Dead : 0

Abstract

An explosion occurred at a commercial incineration facility. The incident involved drums containing hazardous waste. Significant damage occurred to the facility.

An investigation into the incident found that the drums contained primary and high explosive materials. The drums were not properly marked or labelled. The company was fined \$40,000 (2000).

[damage to equipment, labelling incorrect, design or procedure error, incinerator]

Lessons

Mis-classification of any hazardous material is a very serious matter because it can result in improper handling of the material by the carrier and may cause danger to emergency personnel responding to an incident.

Source : ICHEME

Location : ,

Injured : 6 Dead : 3

Abstract

Ball valve blow-out on propylene system. A ball valve failed and released liquid propylene, which lead to an explosion. The incident was caused by the ball valve being fitted in the wrong direction. There was damage to equipment damage and material loss. Fatality.
[valve failure, installation inadequate, product loss, maintenance]

Lessons

Maintenance workers must be trained not to attempt to work on any item with which they are not 100 percent familiar as to its construction, and when necessary to seek information before starting, if they have any doubts. Supervision must play a vital part in ensuring that those instructed to do a job are provided with the correct information to avoid incidents. Manufacturers drawings unfortunately sometimes leave much to be desired, which means that someone with first-hand experience of the item is very valuable in preventing incidents.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Near miss during work on live foul gas system. Contractors were in the process of removing a valve from a live, foul gas system in the high pressure lube oil hydrogenation unit when they were stopped by a senior foreman who happened to be passing by. Foul gas containing more than 1000 ppm of hydrogen sulphide would have been released had the valve been fully removed.

It was found that the contractors' supervisor had mistaken the foul gas for the plant steam system.

[maintenance, contractor error]

Lessons

Work on plants which are only partially shut down and isolated can present potentially hazardous situations for maintenance crews; therefore, equipment/pipe work releases need to be done with great care. Work lists and permits, with precise permit conditions and equipment locations, must be adhered to.

Source : ICHEME

Location : ,

Injured : 7 Dead : 0

Abstract

Fire at hydrofiner compressor on a refinery. During recommissioning, the west recycle gas compressor on a hydrofiner was overpressurised. The cylinder head was blown off, resulting in explosive decompression and fire. It was found that the discharge valve was installed in the wrong direction. The cause was the criticality of the task to replace the valve not being understood or reflected in procedures. Though the compressor was purchased to the standard of API 618, which

requires a design that prevent valves from being installed in the wrong direction, the equipment did not meet specification.

Production losses and repair costs were estimated at \$500,000 (1995) (£318,300) and \$400,000 (£254,600) (1995), respectively.

[fire - consequence, overpressurisation, installation inadequate, product loss]

Lessons

There have to be measures in place, as part of contractors' and suppliers' quality assurance programs, where critical issues on machines are identified and reviewed.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Failure on new gas compressor. A valve cover on the suction side of a recently commissioned reformer blew off. Process technicians who were working in the area were alerted by the noise of escaping gas. Their prompt investigation quickly identified the cause of the gas release; and the unit was shut down by activation of the emergency shutdown system in central control. It was found that the studs on the valve cover failed in fatigue, the result of not having all be torqued to the specified level. The cause of the accident was the manufacturer not communicating the criticality of even torquing of valve cover studs and not including the checking of valve cover studs in its "field installation checklist".

[metal fatigue, inspection inadequate, processing]

Lessons

The need for stud/bolt torquing on flanges and other closures requires engineering assessment at installation and subsequent maintenance actions, taking account of system parameters and criticality.

1941 28 August 1995

Source : LLOYDS LIST, 1995, AUG.

Location : Zamboanga, PHILIPPINES

Injured : 21 **Dead** : 2

Abstract

An explosion occurred which was caused by cigarette embers. The explosion rocked the fireworks factory. Fatality.

Lessons

[None Reported]

8241 25 August 1995

Source : LLOYDS LIST, 1995, DEC, 27.

Location : , SINGAPORE

Injured : 0 Dead : 0

Abstract

300 tonnes of oil spillage into the sea from the refinery when a valve on a pipe was left open after maintenance work.
[operator error, refining]

Lessons

[None Reported]

Source : SEDGWICK LOSS CONTROL NEWSLETTER, ISSUE 4, 1995.

Location : Cabinda, ANGOLA

Injured : 0 **Dead** : 0

Abstract

Sinking of offshore drilling semi submersible platform caused 24 people to be evacuated. Cause attributed to someone "pushing the wrong button".
[evacuation, operator error]

Lessons

[None Reported]

Source : ICHEME**Location :** , USA**Injured :** - **Dead :** 0**Abstract**

A newly constructed delayed coker unit was started at a refinery in early May of 1995. In July of the same year, a major fire occurred which resulted in substantial equipment damage and unit downtime. There were no serious injuries but the total loss exceeded \$15 million (£8,955,224), (1995).

The design feed and process parameters of the unit were such that shot coke was expected (granular coke as opposed to a solid bed). Due to known difficulties with handling of shot coke, the design included an automated coke drum bottom head removal system. The intent here was to protect the operators from the hazards of removing the bottom head. The bottom de-heading device used hydraulics, high pressure nitrogen and a movable ramp ring to seal the coke drum head prior to the introduction of hydrocarbon. Hydraulic power is used as the motive force for moving the ramp ring and lock ring used to secure the bolts. Positioning the bolts and locking them into position with the lock ring is the first step in installing the head. Following that, high pressure nitrogen is used to tension the bolts and provide enough clearance so the ramp ring can be moved into position. Hydraulic power then rotates the ring until a mechanical seal has been achieved. The hydraulic and nitrogen systems are then powered down and the drum is ready for pressure testing prior to introducing hydrocarbons. The control panels for the device are located such that the operator is shielded but able to clearly see the bottom head area.

On the day of the incident the day shift operator installed the head on Drum No.1. He proceeded with pressure testing and air-freeing of the drum and then began hydrocarbon warm-up in preparation for a drum switch later that night. The investigation revealed that the ramp rings were never closed on the drum and that the seal was provided by the nitrogen pressure. The evening shift operator completed the switch into Drum No.1 and then in his routine check of the system discovered that the head was not properly installed. He then compounded the previous error by shutting down the nitrogen system prior to closing the ramp rings. The head subsequently opened up and there was an immediate fire. The investigation concluded that the human error was the primary cause for the event. It was clear that not all of the operators fully understood how the deheading device worked and thus were unable to troubleshoot the device. It was also clear that while the procedure for operating the device was very clear, not much was said about what was going on as the different steps were occurring. It was also concluded that the safeguards to minimize the potential for operator error were inadequate given the consequences of such an event. The equipment design did not include any inherent protection against the head being mistakenly opened while the drum was in service. Additionally, the cross checking procedures in place at the time were deemed inadequate.

[fire - consequence, damage to equipment, operator error, design or procedure error, competency lacking, drums, processing, injury]

Lessons

Operators should have fully understood how the drum's de-heading device operated.

Adequate safeguards should have been in place to minimize the potential for operator error through the following:

- 1.inherent equipment design.
- 2.cross/double checking arrangements.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Sulphur pit explosion at a refinery. A flashback from the incinerator ignited an accumulation of acid gas in the sulphur pit. The cause of this accident was a previous modification to the sulphur pit design when the unit amine sump vent was connected into the sulphur pit vapour space. This allowed hydrogen sulphide to accumulate in the sulphur pit vapour space. The amine sump had originally been fitted with an atmospheric vent.
[near miss, design inadequate, refining, contamination, modification procedures inadequate]

Lessons

Allowing for understandable technical reasons, the contamination of the sulphur pit with drainings from the amine sump was undesirable, especially with the limited control over quantities being drained.

Source : LOSS PREVENTION BULLETIN, 069, 25-28; FINANCIAL TIMES, 1983, 19 SEP.

Location : , UK

Injured : 0 Dead : 1

Abstract

An explosion in the hydrocarbon recovery plant caused considerable damage to the adsorber and other equipment as it was being shutdown. Flammable gases were drawn into the blower/heater/adsorber circuit, mixed with air and ignited on a hot spot in the carbon bed. The possibility of air, vent gases and hot spots in the carbon bed had not been identified at the design stage. Fatality.
[separation equipment, design inadequate]

Lessons

The following recommendations were made relating both to improving the safety of the plant and improving procedures.

1. New procedures for shutting down and starting up the plant should be established which avoids the process use of air. The recommended procedure involves placing the bed under nitrogen cover after extended steaming followed by cooling by water flooding. This leaves the carbon bed cool and wet prior to opening up for entry and the beds should be kept wet when open for maintenance. Restart of the plant would use plant off-gas to dry the beds. For a shutdown where entry to the absorber is not required, the absorber would be simply extended steamers and left to cool down under nitrogen cover.
2. A discipline and design practice should be established to deal with programmable logic controllers. In particular functional description sequence diagrams, etc., should be prepared by the design team in terms intelligible to operating personnel and should be treated as addenda to P&I diagrams.
3. The existing temperature measuring point in the outlet gas 'Y' piece from each absorber should be relocated so as to measure both the outlet gas and the regeneration outlet gas temperature.
4. Operating instructions for shutdown and start-up will need complete revision.
5. The procedure for monitoring and controlling changes to an agreed design should be improved and method of referral back to the original design team for approval of significant changes established.
6. Changes of personnel at critical points in a project should be avoided if at all possible. If such changes occur, management must ensure that continuity is maintained and that successors are fully aware of important design and operating aspects. Overlap from design to operation is essential to ensure that operating practice does not dilute design intent.
7. It is recommended that the company guidelines for the implementation of the technical safety procedure for project development be revised.
8. To make the necessary separation of design responsibilities and the safety auditing responsibilities of technical safety group clear, with guidance on the implementation of the latter.
9. To give clear guidance on standards of reporting.
10. To state clearly the inherent responsibility of line management to ensure that the review of procedures is followed, that the scope and the depths of the reviews are adequate and that the technical safety group report gives a clear statement of activities and outstanding actions.

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

Injury at steam condensate sump. While assisting with the modification of some pipework in the steam generation area, a process technician lost his balance, and his right foot and lower leg were submerged into a steam condensate sump. There were no guards or barriers around the sump. In addition there was generally poor housekeeping in the area, including temporary scaffolding and numerous hoses in the vicinity and a lack of suitable warning signs. The site regulations relating to sumps and pits were not followed. There was also a lack of awareness by personnel working in the area of the severe hazard presented by the open sump. A more rigorous safety assessment of the area prior to the issue of permits should have identified the hazard.
[inadequate guarding, safety procedures inadequate, permit to work system inadequate]

Lessons

Holes left by the removal of equipment, however temporary, must not be tolerated. Either securely cover the opening or provide guards/warning signs.
Work permit issue requires actual work site evaluation to consider the potential hazards that may be generated by the work to be done.
Supervisors need to monitor work being done to spot potential hazards.

2519 02 June 1995

Source : LLOYDS LIST, 1995, JUN, 3.

Location : Jaipur, INDIA

Injured : 0 Dead : 9

Abstract

A toxic gas release at a water treatment plant from an underground chamber at the plant after an operator opened a pipeline valve. The operator succumbed to the gas immediately and 8 other operators were killed as they one by one came to check on the welfare of the first victim. Fatality.
[asphyxiation, gas / vapour release, operator error, drains & sewers]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Drain line failure on catalytic reformer on a refinery. During the application of a temporary clamp over a pin-hole leak, a drain line from the level switch bridle on the catalytic reformer compressor dry drum failed catastrophically. There was a gas release; but it, fortunately, did not ignite. There was damage to equipment and product loss.

It was found that the wrong type of sleeve was fitted to the line, and that excessive tensile load was applied to line during injection of compound. The basic cause was that the sleeve was not approved prior to installation as required by procedure.

The procedures did not specifically address the possibility of over stressing from hydraulic effects.

[gas / vapour release, installation inadequate]

Lessons

The task of temporary repair to pipework using the "Furmanite" injection technique is a highly technical one which requires a sophisticated level of control to avoid disasters.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

MTBE (methyl tert butyl ether) spill from hired barge. A marine transportation incident. A tank barge, loaded with a cargo of MTBE was being pushed on a waterway when the crew of the tugboat detected a strong smell of MTBE. A water dip on all cargo tanks led to the discovery of a hole in the barge. It was found that the barge was holed prior to loading of MTBE, at which time MTBE began being released. The cause was the lack of a thorough check of the barge prior to loading.

[spill, inspection inadequate]

Lessons

There is difficulty in detecting hydrocarbon (e.g., MTBE) spills on the water for hydrocarbons that are miscible with water.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Reformer extended outage on a refinery. During a planned shut-down to regenerate catalyst, internal damage and a loss of catalyst containment occurred within the reactor system. It was found that the catalyst beds were disturbed and the seal at top of reactors lost allowing the catalyst to migrate out of reactors. The cause was due to the current regeneration procedure not adequately alerting personnel to problems during the regeneration process. Current data and tracking capabilities did not indicate any potential problems within the reactors.

Loss including \$3.5 million (1995) and £2.1 million (1995) in lost opportunity.

[damage to equipment, product loss, reactors and reaction equipment, safety procedures inadequate]

Lessons

Procedures acceptable over many years still need review when operating parameters are changed e.g., feed rates, feed quality, and severity of operation.

Source : HAZARDOUS CARGO BULLETIN, 1995, APR.; EUROPEAN CHEMICAL NEWS, 1995, FEB, 27.**Location** : Essen, GERMANY**Injured** : 4 **Dead** : 1**Abstract**

An explosion and fire occurred at a chemical plant applying silicone coatings. The blast occurred when some polymethyl hydrogen siloxane was accidentally fed into a reactor, together with the correct feedstock, allyl glycidyl ether. The two epoxides reacted, overheated and hydrogen burst out of a ruptured pipe into the building, where it mixed with air and exploded. The 5 workers were caught in the resulting fire. According to the Company, the police believe that human error is to blame. Although both chemicals were labelled, they were stored in drums of the same colour. Damage is put at DM 10m \$6.7m (1995). Fatality.

[fire - consequence, human causes, damage to equipment, identification inadequate, overheating, chemicals added incorrectly, charging reactor, reactors and reaction equipment]

Lessons

[None Reported]

Source : HAZARDOUS CARGO BULLETIN, 1995, APR.

Location : , INDIA

Injured : 0 Dead : 0

Abstract

An explosion and fire occurred in a gas cylinder store. Worker's cigarette is thought to have caused fire.

[fire - consequence, storage]

Lessons

[None Reported]

8495 21 January 1995

Source : LLOYDS LIST, 1995, JAN, 24, JAN, 25.

Location : Lac sur Sables, Shawinigan, CANADA

Injured : 0 **Dead :** 0

Abstract

A rail transportation incident. 28 cars of a 44 car train were derailed causing the spillage of 50,000 gallons of sulphuric acid into the river. The pH of the river was down to 3.7 at the spill and 5.0 16 km away. Limestone was added to the river. Investigation showed that one tanker split open completely, 10 tankers tipped into the lake and, that of these, 6 leaked, while 5 other tankers lost some of their contents. 10 of the 11 cars that lost their contents had damage to the top assembly and rupture disc due to the shield being insufficient.

[damage to equipment, pollution, inadequate guarding, derailment]

Lessons

There was a lack of shielding on the tanker domes.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Jet fuel tank spill at a refinery. During a period of low ambient temperatures, the sight glass on a storage tank water drainage piping failed, and 8,200 bbls. of Jet A fuel was released. The sight glass failed due to expansive forces as water in piping froze. There was also deviation from procedure when water was not being drained. The basic cause was poor design of electric heat tracing which did not prevent water inside draw piping from freezing and there was inadequate procedure for isolating water draw-off.

[weather effects, storage tanks, isolation inadequate, aviation fuel, gauge glass failure, jet fuel]

Lessons

Job task observation is required to ensure that intended operational procedures are, in fact, followed.

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

Improper alignment of valve. Workers began heating a tank containing an acid solution used to de-scale heat exchangers. The tank was unintentionally filled to 100 percent and, when an operator was in the process of removing the inspection port, the pressure in the tank forced the port off the tank and the operator was sprayed with the acid solution. Extreme pressure had built up under the inspection port, and the steam supply by-pass valve to the heating coil was not aligned. The basic cause was the improper installation of by-pass valve, which increased the amount of steam going to the coil.

[installation inadequate]

Lessons

When working with high energy sources, such as steam, ensure that extreme care is exercised, repairs double checked, and that system valves are correctly identified/labelled.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Steam supply near miss. During a draining operation, a pipefitter encountered high pressure in a line thought to have been isolated. In fact the line had not been isolated when work was begun. In addition the work crew had failed to obtain a work permit, and valves in work area were not labelled.

Facility's engineer, who authorised the job, had instructed lock-out/tagout crew to isolate the wrong valves. A work permit would have provided pipefitter with better information about the valves, hot lines, and unusual problems.

[permit to work system inadequate, labelling incorrect]

Lessons

Isolation of systems must be verified before starting work on them. For single valve isolation, a full review of flow diagrams, site line-up, and permit requirements should ensure that the correct valves are identified to secure the work area.

124261995

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

An incident occurred when a specialist piling sub-contractor was carrying out operations at a construction site. As a pile was being hoisted prior to driving, the hoisting sling slipped from the pile. The pile fell onto the driver's cabin, crushing it and killing the driver.

An investigation into the incident revealed that the pile had slipped as a result of tension being lost in the hoisting wire and sling during the dragging and lifting operations. In addition the inspection of the rig revealed signs of wear and tear that indicated that work methods had been in use that were not compatible with the design of the rig.

[lifting equipment, fatality, incorrect equipment installed, additional incorrect operation, transport]

Lessons

[None Reported]

124241995

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An incident occurred at a refinery involving a crane. The incident occurred when a load of scrap metal was to be lifted onto a trailer. At some point in time the crane operator was in the process of lining up a piece of chain, weighing about 8 tonnes on the crane load indicator, on the rear end of the trailer. In order to lay the chain on the trailer properly he swivelled the crane boom past the centre line of the trailer and during this action the crane toppled over. The crane boom smashed on the co-driver side of the prime mover missing the driver who was sitting inside. Fortunately no personal injuries were sustained.

[near miss, plant / property / equipment, safety procedures inadequate, management system inadequate]

Lessons

[None Reported]

124251995

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A contractor working in an electrical substation of a production plant was electrocuted.

The incident occurred

An investigation into the incident revealed:

1. The victim was found inside the coupling cell.
2. The safety shutters in that cell which should prevent access to the connections were open.
3. There were no electrical faults in the coupling cell; the upper parts in the coupling cell (connected to the live section) were at 6 kV and the lower parts (connected to the section which had to be worked on) were not under voltage.

[electric shock, fatality, maintenance, safety procedures inadequate, electrical]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 130, 8-10.

Location : ,

Injured : 0 Dead : 0

Abstract

During a routine relief stream inspection two bursting discs were discovered in one holder. It is believed that the two discs were installed during commissioning two years previously.

The incident occurred on a research plant which was commissioned in 1993. The two discs were discovered during the first routine, two yearly inspection of the relief streams in 1995. Pressure systems records confirm that there was no interim replacement of the discs on this relief stream, so that the two discs were almost certainly installed during commissioning in 1993.

The bursting disc holder and five discs were purchased by the project team from a reputable manufacturer. The discs were 0.625 inch (1.59 cm) diameter, thickness 0.004 inch (0.1 mm) with a burst pressure of 120 bar at 300 degrees C. The holder was passed to the construction contractor for installation on the plant and the five discs were retained by the plant supervisor.

Following normal commissioning practice, the bursting disc was installed by a plant fitter. This involved removal of the holder from the plant, dismantling it in the workshop, reassembly of the holder with the disc in place and installation on the plant. Installing the disc in the holder was therefore done in clean workshop conditions. The disc, which is individually packed in a cardboard box, was supplied by the plant supervisor.

Following the incident the four discs remaining from the original order were found in the plant store. Discs of this type are not used elsewhere on site and it is most unlikely that similar discs were available in the workshop.

The two discs that were found during the routine inspection were a very close fit together and were difficult to separate. Most observers were not able to detect the double disc. The four remaining discs were checked, by measuring the metal thickness on the flange, and all found to be single.

[incorrect equipment installed, installation inadequate]

Lessons

The following recommendations were made:

1. The incident should be raised again with the supplier, seeking a more formal and authoritative reassurance that their procedures can prevent repetition.
 2. Share information about the incident through Safety Departments and Engineering Departments both inside and outside the company.
 3. Implement a procedure for checking discs before installation.
 4. Include the requirement for checking the disc on the 'Scheme of Examination for the relief stream'.
-

8484 06 December 1994

Source : LLOYDS LIST, 1995, JAN, 1,; HAZARDOUS CARGO BULLETIN, 1995, MAR.

Location : Shanxi, CHINA

Injured : 0 Dead : 100

Abstract

A rail transportation incident. A guard's cigarette set fire to trackside bush. The ensuing fire engulfed two trains with carriages containing 60 tonnes of TNT, dynamite and detonators.

An explosion occurred devastating four nearby villages.

[fire - consequence, trinitrotoluene, fatality]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Catalytic cracker vapour line deformation. During start-up of the reduced crude conversion unit (a heavy oil cracker), the reactor vapour line was heated up to a temperature sufficient to ignite coke in the line, resulting in overheating and deformation of the line. There was damage to equipment. It was found that the line was heated beyond its maximum capability. The cause was due to inadequate instructions, concerning operating limits, in the start-up procedure for the operators. In addition an air line heater outlet temperature indicator was not properly calibrated to read above the maximum allowable temperature.

[faulty instructions, cracking]

Lessons

Start-up procedures should include consequences of deviation as well as procedural steps to take to control temperatures and quench the reactor.

6733 19 October 1994

Source : OIL & GAS JOURNAL, 1994, 26 DEC., 27.

Location : Torrance; California, USA

Injured : 21 Dead : 0

Abstract

LPG pipeline was being brought back on line after maintenance work when there was a leak at a flange which ignited.

[flange leak, fire - consequence, start-up, inspection inadequate]

Lessons

[None Reported]

Source : HAZARDOUS CARGO BULLETIN, 1995, JUN.

Location : Norwich, UK

Injured : 0 **Dead** : 1

Abstract

A road transportation incident. A driver slipped and fell 12 feet from the walkway running along the top of the tank vehicle during fuel oil loading operations at a depot. The driver was taken to hospital but died nine days later from leg injury complications. The failure to install safety rails was the cause to this incident.

Fatality

[safety procedures inadequate, fall]

Lessons

Rails must be provided for top loading of tankers to prevent a person from falling off.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A smell of chlorine from a bleach plant was detected within the adjacent site. There was some uncertainty about the exact sequence of events. It is believed that routine sampling of the chlorine stream with a syringe led to a very small leak of chlorine into a drain line. This triggered a chlorine detector and led to shutdown of an electrolytic cell. Coincidentally there was a problem with a circuit breaker, which delayed the restart of the plant. On restarting there was a transient high chlorine flow to a reaction vessel that was not fully neutralised. The pH record showed a fall from the normal pH 8 to pH 5. This led to free chlorine being released in a bleach tank, which is only enclosed with a loose fitting lid.

[operation inadequate, gas / vapour release, start-up, design inadequate]

Lessons

The investigation recommended improving the tank ventilation to prevent a recurrence.

Immediate provision of an extract fan was not a complete solution.

A plant HAZOP study was scheduled after a previous incident and it was recommended that the current incident was included in the study.

6701 19 September 1994

Source : THE CHEMICAL ENGINEER, 1994, 27 OCT.

Location : Jarrow, UK

Injured : 0 Dead : 0

Abstract

A spill of 3 tonnes of butyl acrylate occurred into a river due to an operator opening the wrong valve.

[operator error]

Lessons

[None Reported]

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1994, OCT.; LLOYDS LIST, 1994, 8 NOV.

Location : , HONOLULU

Injured : 0 Dead : 0

Abstract

A man in charge of monitoring fuel oil transfer via a pipe to a barge left his post and barge overflowed spilling 1300 gallons into harbour.
[material transfer, pollution, operator error, marine transport]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A fire occurred on an absorber tower piping. After an equipment modification, there was a severe surge created, with major vibration. Flange leaks, loss of containment, and fire followed. There was damage to equipment. It was found that the control valve was oversized which led to surge condition within piping.

The basic cause was that the management of change system did not require engineering specialist reviews for control valve changes.

[maintenance inadequate, fire - consequence, management system inadequate]

Lessons

Management of change processes should include clear requirements for the various types of equipment, and, as a minimum, should cover the following: pertinent documentation, relevant calculations, and special reviews by engineering.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A leak of 500 kg of (CS₂) from a flange in a pump house into a water filled containment sump over a period of time. Detector systems alarmed and the leak was contained. The area was hosed down following the leak and a pipe fitter stripped down the pipe upstream of a CS₂ metering station, once the system had been isolated. A 1 inch flange gasket was found to be in very poor condition and replaced. Production restarted but within a matter of hours a second meter station flange developed a similar leak. The system was cleaned down and all flanges in the metering station pipework had new gaskets installed as a precaution. Subsequent investigation showed that the meter station filters had been replaced 6 days before the incident, which involves replacing the gaskets. The correct gasket was specified for the duty. Further investigate showed that the suppliers supplied acid specification gaskets instead of acidit gaskets. These were of a lower specification not suitable for CS₂ duties. This fault was not picked up by the site prior to fitting.

[gasket failure, spill, installation inadequate, maintenance]

Lessons

Improvement required in goods inwards procedures to confirm that correct materials have been supplied as ordered.

Source : CHEMISTRY IN BRITAIN, 1994, DEC.; ENDS REPORT, 1994, AUG.

Location : Warrington, UK

Injured : 0 Dead : 0

Abstract

1.2 tonnes of vinyl chloride monomer (VCM) released due to operator misinterpreting computer data during polymerisation.
[operator error, pollution, gas / vapour release]

Lessons

[None Reported]

Source : OCCUPATIONAL SAFETY AND HEALTH OBSERVER, A COMPENDIUM OF LESSONS LEARNED, OCTOBER 1994.

Location : , USA

Injured : 0 Dead : 0

Abstract

A petroleum reserve was shut down due to an employee being found working outside a platform area over a river without using the required fall protection or personal flotation device.

The failure to use appropriate personal protective equipment represented a condition of imminent danger and violated OSHA regulations stipulated in 29 CFR 1926. 106(a) and 29 CFR 1926. 104(a).

The worker was directed to a safe location and work stopped for investigations.

The next day, all subcontractor personnel were retained on the importance and proper use of personal fall protection and flotation equipment.

Although this incident resulted in a near-miss occurrence, it could easily have ended in a serious injury or fatality.

[plant shutdown, safety procedures inadequate, near miss, personal protective equipment]

Lessons

To prevent accidents, management must do more than post signs and provide training on the use of fall protection and safety procedures. An environment that actively nurtures an awareness of safety at all personnel levels is also necessary. Such an environment will emphasize safety over production, and workers will be able to recognise and question any potentially unsafe instruction or action without fear of reprisal.

Source : LLOYDS LIST, 1994, 6 JUN.; ICHEME

Location : Lavera, FRANCE

Injured : 5 Dead : 2

Abstract

A crude oil distillation unit at a refinery was shut down and undergoing major overhaul. The main fractionating tower and associated pipework had been flushed and emptied, steamed, water washed and isolated following normal procedures. Work permits had been issued to contractors permitting entry; cold work; and, subject to special permission, hot work. Before the incident, work had already been carried out in the tower and internal manways removed from the 48 trays in the tower.

On the morning of June 4, a contractor was granted permission to cut a coupon from a relief valve pipe on the lower end of the 50 inch tower overheads line. This line was open to the tower top and had open ends at the overhead/crude exchangers. A satisfactory gas test and a visual inspection was conducted through the relief valve stub. The difficulty of effectively draining the overheads 50 inch line was demonstrated when a sample of gas oil was later recovered from it some 20 meters or more distant from the tower. This gas oil was almost certainly distilled over during the steaming out stage. It is probable that a fire started inside the line at the point of hot work, as evidenced by the welder's statement and confirmed by the melting of a synthetic textile sling in contact with the pipe. This melting was subsequently shown to require a temperature of about 300 degrees C. It would appear that the resultant smoke and hot vapours ascended the overhead line to the top of the tower. This upward flow was probably assisted by the aerodynamic effect of the 4.5 m/s wind around the 7.8 meter diameter tower, which induced a draft at the manway door. Once hot vapours started to rise up the line, a strong chimney effect resulted, rapidly carrying smoke and fumes to the top of the tower and out of manway. The scaffolder working in the tower dome detected the fumes and, fortunately, managed to escape. Smoke and fumes were then carried down the tower to lower manways by a down draft around the tower. It was this rapid penetration of smoke down the tower which most probably asphyxiated the two company personnel.

There were reports of pyrophoric fires within the top section of the tower during the incident. Scale believed to have been earlier taken from trays removed from the tower, indicated the presence of iron, sulfur and some combustible material. The elevated temperatures produced by the hot fumes from the overhead line would have dried out pyrophoric deposits in the upper section of the tower and caused them to ignite.

The actions to extinguish the fire were hindered by two factors.

1. The inability to get sufficient water to the top of the tower.
2. General lack of knowledge about the original fire in the overhead line; although the welder and the safety agent were both aware of this fire, they did not believe this to be relevant to the attack on the fire which they now perceived to be in the tower. Firewater was introduced into the manway by 10:15 hours, but this proved ineffective. The difficulty in raising hoses up a 70 meter tower in high winds complicated the fire attack and also resulted in injuries to personnel. Eventually it was decided to de-spade the top reflux line to introduce water; and this was successful, the smoke subsiding by 12:00 hours.

Immediate causes:

The method of isolation and hydrocarbon freeing of the tower and contiguous systems did not satisfactorily drain all liquid from the large 50 inch overhead line. Hot work on the overhead line most probably caused an internal fire, the line was free of gas but not hydrocarbon free.

The resultant hot combustion products entered the tower from the overhead line and were pulled down the tower and out of the lower manways by an aerodynamic effect produced by the wind.

These combustion products almost certainly promoted subsequent pyrophoric fires which may have been fuelled by carbonaceous deposits.

Personnel were working in the tower at the time when the fire broke out in the overhead line.

[fire - consequence, fatality, entry into confined space, hotwork, distillation, draining of line insufficient, isolation inadequate, management system inadequate, weather effects, asphyxiation, injury]

Lessons

Be aware of the risks posed by pyrophoric deposits in vessels which are shutdown and subject to entry - expect them on any unit containing H₂S or high sulphur materials - and initiate a programme of nightly water flushing until vessels are free of pyrophoric material.

The term "gas free" does not simply mean "vapour free" testing and inspection of equipment must encompass checks for materials which could produce flammable/ toxic vapours on heating, or other hazards such as pyrophoric deposits or lack of oxygen.

Gas testers and those involved in the issue of permits must have sufficient technical background to understand the complexities of ensuring safe permit conditions, especially when entry and hot work is involved.

Sites must establish sufficient control systems to ensure that work being done does not hazard other adjacent personnel, it is particularly important to protect personnel in confined spaces.

Well trained rescue teams are needed to safely attempt rescues in situations such as encountered in this incident. Sites need to plan how best this can be achieved rapidly.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A fire and fatalities occurred at crude unit on a refinery. During major overhaul work, a fire developed in the main fractionating tower. It was found that there was inadequate isolation and hydrocarbon freeing of tower prior to hot work, and the approval to carry out work in tower was granted without knowledge of hot work to be performed. After investigation it was found that the hot work was authorised because the agent did not recognise the liquid in pipeline as gas oil, he was also unaware that absence of explosive atmosphere did not mean hydrocarbon free. In addition. Inadequate work planning, matching of experience with task, no knowledge of work being simultaneously carried out also contributed to this accident. Fatality.

[operator error, fire - consequence, testing inadequate, refining]

Lessons

1. Testing and inspection of equipment must encompass checks for materials which could produce flammable/toxic vapours upon heating, or other hazards such as pyrophoric deposits or lack of oxygen.

2. Gas testers and those involved in issuing permits must have sufficient technical background to understand the complexities of ensuring safe permit conditions, especially when entry and hot work is involved.

Source : LOSS PREVENTION BULLETIN, 120, 9-10.

Location : ,

Injured : 0 Dead : 0

Abstract

Combustion in the vapour space of a 1300 litre chlorination kettle resulted in a burst rupture disc and release of black smoke outside the production building. Another combustion occurred about 15 minutes later just after the feeds to the reactor had been shut off. There were no injuries or equipment damage and no material release other than the smoke. The combustion resulted from a mixture of chlorine gas and ethyl acetate vapour in the head space of the kettle. Several factors contributed to the incident:

1. Operators had changed a procedure, shutting off a pump rather than the flush valve, without considering this to be a change that required a safety review. The valve was considered difficult to operate but no one had requested that it be repaired. Although the operating instructions are initialled after each step, which should help ensure consistent practice, the timing for closing the valve was not spelled out correctly.
2. The operator who started the chlorination did not completely check the positions of all the valves. He physically checked the reactant valve and that convinced him that his partner had completed the set-up procedure. Only then did he look at the flush valve to check its position.
3. There were indications of lack of reaction, for example a slow exotherm, but the operator thought there was a cooling problem. Similar symptoms had occurred recently due to a cooling problem. The reactant feed was indicated only by a mass meter on the reactor vessel. No additional independent check of the feed to the vessel was required by the operating instructions. The mass meter indicated the right feed rate but, in this case, for the wrong material. The chlorine feed did have an independent check procedure. Cross checks should be fundamental for any feed system. During the early project stage hazard studies plant and research technical personnel did not recognise the possibility that chlorine/solvent combustion could occur if the reactant was not present. Therefore specific precautions were not considered at the time. A separate major hazard assessment for chlorine release had been made, but the reaction vessel was not included in the analysis because chlorine was to have been consumed at that point. Prior HAZOPS covered different solvent systems. [fire - consequence, operator error, processing]

Lessons

The following corrective actions were taken:

1. The existing site management of change procedures were reviewed with all operators, emphasising what constitutes change. The trainers focused on presenting the management of change concepts in language that was meaningful to the operators. The procedures for check-out of equipment prior to start-up were also reviewed.
2. A fundamental review of the process determined that the ethyl acetate flush procedure could be eliminated altogether. The line was blanked.
3. A reactant weight-loss cross check and lack of reaction checks, based on colour change and exotherm rate were added to the operating instructions.
4. A HAZOP was held for the chlorination process. Major recommendations included a better inerting procedure (although oxygen did not appear to be involved). Also feed control and interlocks based on reactant feed were considered inherently safer than those based on chlorine feed.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Total refinery power supply failure. All external electrical power supply was cut from the duplicate feeders to the refinery, resulting in an of all process units. It was found that there had been unauthorised switching of electric power. It is not clear why the unauthorised switching of electric power was allowed to take. Had there been adequate leadership/supervision, this event would not have occurred. An independent air supply would have enabled steam generation until emergency power was available.

[safety procedures inadequate, refining]

Lessons

Sites need to be aware that, even with two separate electrical feeders, power can still be lost from circumstances beyond their control.

Alternative instrument air supplies back up for essential users should be available.

Source : LOSS PREVENTION BULLETIN, 128, 3-5.

Location : ,

Injured : 0 Dead : 0

Abstract

A high pressure reactor ruptured during a catalyst activation operation. A gaseous stream of hydrogen and light hydrocarbons was released and spontaneously ignited. The unit was immediately shutdown and depressurised. The fire was limited to the vicinity of the ruptured reactor and was extinguished within twenty minutes by onsite emergency services. There were no injuries but damage to equipment included the reactor and some piping, instrumentation and air-fin heat exchangers on an adjacent structure.

An investigation was carried out and the causes identified. The operation in progress was a catalyst activation process which involved reducing an oxide coated form of the catalyst in the presence of hydrogen to its base metal form. The fresh catalyst to be activated was loaded in the top bed of a three bed reactor. The lower two beds of the reactor already contained previously used catalyst. In order to activate the fresh catalyst in the top bed, hydrogen had to be passed over the catalyst for a period of four hours at relatively high temperature and pressure. Target activation temperature was higher than the normal operating range of 300-380 degrees C, but within the reactor design temperature. The hydrogen used was from the site system and contained 70% hydrogen and 30% hydrocarbons in the range C1 to C5 with trace C6+. Since the reactor was a stacked bed reactor with entry at the top, the hydrogen rich gas had to pass over the fresh catalyst and then the older catalyst beds.

The gas was initially warmed-up via a furnace and passed through the reactor. As the inlet bed temperature target was approached, the furnace coil outlet temperature overshot its set point and three out of the four top bed temperature instruments went out of range, with the temperature at the bottom of that bed exceeding the vessel design temperature. In response, furnace firing was reduced and quench gas flows were increased to the reactor. Temperature control was poor as the furnace was tuned for normal process liquid/gas operation rather than gas-only activation. Two hours into the activation, the top bed temperatures had steadied out around the target activation temperature but the bottom temperature reading in that bed and all eight of the temperature readings in the two catalyst beds below remained offscale, beyond the design temperature of the reactor.

The activation step was completed two hours later and the reactor cooled down. Three hours into the cool down phase, the reactor, which had a diameter of one metre and a wall thickness of 50 mm, ruptured at the base of the middle catalyst bed.

[spontaneous combustion, fire - consequence, temperature meter/control, processing, operator error, reactors and reaction equipment]

Lessons

This was only the second time that the activation had been performed on this catalyst system. In hindsight, the actual processes occurring within the reactor were not fully understood and the job preparation could have been improved. However, the root cause of the incident was that temperature instrument readings were discounted. Safety refresher training must emphasise that instrumentation and alarms must not be discounted and, where data conflict, a defensive position should be chosen and a safe operating regime established at all times.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A FCC (Fluid Catalytic Cracker) bottoms pump fire. While maintenance work was being carried out on the already isolated bottoms reflux pump, there was a release of catalyst and fractionator bottoms which formed a cloud. There was no check made to assure the system was depressured. Catalyst had plugged the discharge valve seat, preventing complete closure of the discharge block valve. The cause was due to the Lock Out/Tag Out system being unclear as to whether isolation and depressuring should be verified before the release of equipment to maintenance, and the location of pumps encouraged catalyst laydown in piping. Fatality.

[fire - consequence, spill, design or procedure error, gas / vapour release, isolation inadequate]

Lessons

In isolating, as well as de-isolating, adequate checks are essential before opening flangers or removing end blanks, to ensure that pressure has not built up by leakage through the valves.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A release of crude oil causes shutdown of a crude distillation unit at a refinery. Spill.

The incident occurred when a loss of lubricating oil pressure caused the turbine driven desalted crude oil pump to shut down. Pressure build up and unsuccessful attempts to start/re-start pumps led to mechanical equipment failure of the relief valve's bellows and failure of adjoining piping. It was found that carbon steel tubing, which transmits the lubricating oil system pressure failed. The cause was found to be lack of preventive maintenance and inspection schedules for tubing. In addition pump modifications conflicted with its design and the pump was not tested before being returned to service.

Losses: production loss \$1.7 million (1994), local claims \$10,000 (1994), equipment damage \$160,000 (1994).

[process causes, design or procedure error, maintenance inadequate, refining, mechanical equipment failure, maintenance inadequate]

Lessons

Start-up and change-over switching arrangements for parallel pumps need to be routinely tested and available to operators. Modification to switching arrangements need to be agreed by all concerned and documented.

Source : FIRE PREVENTION, 275, 1994, DEC.

Location : Essex, UK

Injured : 0 **Dead** : 0

Abstract

A company was fined £17000 (1994) for exposing its employees to fire risks during an incident when 7000 litres of highly flammable ethanol was spilled into a yard area from an open pipeline when work was being carried out to remove an area of plant at the site. The ethanol, flash point 14 degrees C, did not ignite. [near miss, safety procedures inadequate, demolition]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A fire occurred on crude distillation unit at a refinery. During start-up of the crude distillation unit, a release of hydrocarbon vapour from the main fractionator column ignited. It was found that thermal stress had led to relaxation of flange bolts and a subsequent release of hydrocarbon. As changes during shutdown and start-up of the unit occurred, inspection and maintenance activities did not increase.

[maintenance inadequate, refining, gas / vapour release, fire - consequence]

Lessons

Operator routine walks through plants should include checking for flange leaks, especially during condition changes, and also during dramatic weather condition changes; e.g., heavy rain may provide thermal stress on hot flanges sufficient to cause relaxation.

Source : ICHEME

Location : ,

Injured : 4 Dead : 0

Abstract

Three contractor employees and one company employee were exposed to a mixture of isobutane and hydrofluoric acid (HF). The amount of HF released was estimated to be less than the equivalent of one pound.

The release, in a small vapour cloud was as the result of breaking containment on a three quarter inch line being replaced during the turnaround.

Although during the emergency there was found to be a failure of the safety showers, quick and effective response by the refinery emergency response team prevented the incident from escalating into a major event. All four casualties were hospitalised, but they were released the next day.

Two were treated for HF burns, and two received precautionary treatment for HF inhalation. Subsequent investigation determined that plugging of the line had inhibited effective line purging, leading to the release after breaking line containment. Once the work permit had been issued, vague instructions, as well as questionable practices, compounded the magnitude of the incident.

[gas / vapour release, permit to work system inadequate, safety procedures inadequate,]

Lessons

The following recommendations were made:

It is essential that systems which have been purged to allow them to be worked on by maintenance be verified as clear before containment is broken.

Techniques used by workers to cut into/open, equipment/lines should be done in such a way as to limit any spillage/leakage as far as possible in addition to the verification by operations personnel.

Safety showers must be regularly checked as being operating correctly. These must not be isolated while any possible need for their use exists on the plant; e.g., usually throughout the turnaround.

HF Alkylation Plants must ensure that they have an adequate emergency response to deal with accidental exposure of personnel to HF, both for burns and respiratory problems. Liaison with outside medical services/hospitals is essential to ensure that correct treatment is rapidly available, with the necessary aftercare.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

During a spading operation on a pair of exchangers, some straight run naphtha was released and ignited on hot residue exchangers located directly underneath. It was found that no checks were made after steaming to verify the system as empty. Naphtha was admitted to the pipeline from passing valves and overflowed at outlet valve onto heat exchangers below. In addition, during prolonged steaming of the system, dirt had collected and piled up in front of the outlet valve.

Losses: approximately \$24,000 (1994).

[operator error]

Lessons

Adequate drainage facilities and safe procedures need to be used to avoid spillages of oil from equipment being prepared for isolation.

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

A process operator fell from a ladder causing injuring to himself. He was climbing a typical chemical plant cat-ladder attached to an access platform when he approached the top and took hold of the safety gate. The gate came off its hinges and he let go. The gate fell forward onto the access platform. He jumped back off the ladder and fell to the ground. His hard hat prevented his head striking the ground. He sustained minor injury to his ankles.
[fall, processing, design inadequate]

Lessons

The design of safety gates used at the top of ladders was faulty. The design allowed the gate to be lifted off the vertical support pin. A welded cap should be fitted above the hinge to ensure it cannot be removed. A number of 'standard' drawings for safety gates were in use on Site, some of which would have prevented this incident. No single standard was being enforced across all plants.

Source : CHEMICALS IN BRITAIN, 1995, AUG.

Location : London, UK

Injured : 1 Dead : 0

Abstract

A third year undergraduate was attempting to make a heterocyclic compound from sodium azide and cyanogen bromide under supervision. The reaction was carried out and the product filtered off the inorganic by-products. They were then dried and scraped off onto a balance pan when there was an explosion. The thumb of the student was blown off. The supervisor was prosecuted under the Management of Health and Safety Regulations 1992 by failing to make 'a suitable and sufficient assessment of the risks health and safety'. He was found not guilty due to his assessment of the hazards being accepted as reasonable.

[laboratory work, safety procedures inadequate, unwanted chemical reaction, bromine cyanide]

Lessons

Carry out risk assessment on laboratory experimentation.

6409 05 February 1994

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1994, APR.; LLOYDS LIST, 1994, 7 FEB, & 8 FEB.

Location : Tabasco, MEXICO

Injured : 30 Dead : 8

Abstract

Workers were cleaning a natural gas pipeline when there was a sheet of fire 1500 ft around the site. The explosion was heard 3 miles away. The 24 inch pipeline was damaged along 60 ft. Crater 660 ft across and 23 ft deep. 500 people evacuated and some houses destroyed.
[evacuation, fatality, fire - consequence, maintenance inadequate]

Lessons

[None Reported]

Source : LLOYDS LIST, 1994, 3 FEB.; THE CHEMICAL ENGINEER, 1996, 25 JUL.; ENDS REPORT NO. 229, 1994, FEB.; HAZARDOUS CARGO BULLETIN, 1994, JUN., 76.; HEALTH & SAFETY BULLETIN, 1996, SEP., 9-12.

Location : Ellesmere Port; Liverpool, UK

Injured : 4 **Dead :** 0

Abstract

A leak of ethyl chloride occurred from a recirculating pump. The release of ethyl chloride solution, hydrogen chloride and catalyst - a toxic flammable corrosive mixture - found a source of ignition and a fire raged until well into the next morning. All non-essential workers were evacuated and neighbours warned. Roads closed. The suspected cause was either corrosion of a valve or a fault on the feeding the valve. The fast release of ethylene chloride suggests sudden failure of a joint assembly.

[maintenance inadequate, evacuation, joint failure, processing]

Lessons

The following actions were taken;

1. insulation cladding on the process vessels;
 2. relocation of the reactor to separate it and possible spillages from other plant;
 3. relocation and enlargement of a run-off lagoon;
 4. reduced vessel connections below liquid level, with shut-off valves;
 5. dedicated pumps, at the point of original failure, simplifying pipework;
 6. extended cladding, level indicators, and flammable gas detectors.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Electrical power outage at a refinery. A major refinery power outage occurred, causing shutdown of the FCC (Fluid catalytic Cracker), Alky, and Coker units, and the once through cooling water system which supplies the surface condenser on the turbine. The operations supervisor opened isolating switch for the wrong 34.5 KV oil circuit breaker. The basic cause was a lack of written procedure for de-energising 34.5 KV loop. The procedure had become too routine and the incorrect switch was pulled out of habit rather than according to procedure. The procedure for using two people to re-energise the loop had been recently altered to allow one person to do this alone, due to manpower limitations.

Losses: estimated \$142,000 (1994), \$122,000 (1994) the result of 10 hours' lost throughput, and \$20,000 (1994) for maintenance on the unit.

[cooling equipment, operator error, design or procedure error, plant shutdown, fluid cracker]

Lessons

1. A written procedure should be prepared and used for each 34.5 KV loop switching.

Line isolation should be done with two people, one to check the other.

2. Communication between control operator and the supervisor de-energising loop serves to verify the procedures as well as to keep the control operator advised as to what exactly is happening should something go wrong.

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A tank fire/explosion occurred at a refinery. While removing the breather valve of a tank, to conduct gauging, an explosion occurred, propelling two workers off the roof. A worker was attempting to use a portable electric saw to cut the tank roof and there was no indication that any testing had been done on the tank to check for flammable materials. Fatality.

[maintenance, hot work, fire - consequence, testing inadequate, electrical]

Lessons

All refinery tank and pipe systems should be checked for flammable contents before hot work, regardless of their previous duty.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Isobutane release at a refinery. A vapour cloud of isobutane and water was released from an isobutane cooler (exchanger). The release was contained and the leak isolated. It was found that the water side of the exchanger froze, resulting in gasket failure between shell and channel cover. Internal failure permitted isobutane to flow into the water side of the exchanger, this mixture of isobutane and water was released through the damaged gasket and from the steam vents which are part of the cooling water return system. The basic cause was a lack of a formal procedure for isolating and winterising the exchanger when it was not being used.

[weather effects, cooling equipment, spill, isolation inadequate, refining]

Lessons

Formal procedure for winterising this equipment should be established.

Source : CHEMICAL HAZARDS IN INDUSTRY, 1995, MAY.

Location : , France

Injured : 0 **Dead :** 1

Abstract

A warehouse employee was asked to clean out an empty a wine vat which had just been emptied. He was later found dead near the manhole at the bottom of the vat. The autopsy found death was due to asphyxiation. Carbon dioxide, sulphur dioxide and hydrogen sulphide had accumulated at the bottom of the vat. Fatality.

[cleaning, warehousing, entry into confined space, testing inadequate]

Lessons

[None Reported]

124191994

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

During recommissioning of a multi-stage LPG pump a near miss incident occurred.

The multi-stage verticle pump was mounted in a barrel sump, a 12 inch pipe of approximately 2 metres ling, which was fixed in grouting.

Upon pressurising the pump, gas leakage followed by an explosion which took place underground, fracturing the concrete and hurling lumps of it around, fortunately without further consequences.

[design inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 2

Abstract

Two workers were killed as a result of asphyxiation. The direct cause of this accident was due to welding work, whilst the two men were inside the column, which ignited gasoil remaining in the overhead line of a distillation column.

The accident occurred during a shutdown of a very large crude distiller, which had a 50-inch diameter overhead line to the condensers.

While the two workers were inside the column, welding work was done on the overhead condenser system where a gas test was made. The large overhead line had only a very small slope, and the gas test did not reveal the presence of virtually pure gasoil lying in the line. It is believed that the gasoil entered the overhead system as a result of steam distillation during the gas freeing operation.

The fumes from the burning gasoil were sucked back into the column by the draught caused by the wind blowing across the open manholes. The fumes asphyxiated the two workers inside the column before they could be rescued.

[fatality, safety procedures inadequate, entry into confined space, gas oil]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 123, 12-13.

Location : ,

Injured : 0 Dead : 0

Abstract

A door to a sodium bisulphite dosing room displayed a hand-written notice stating 'only enter wearing breathing apparatus or ventilate room'. The door of the room was opened and it was found that the room could not be entered due to a high level of irritation to the eyes and respiratory system. Breathing apparatus were to be worn.

On entry it was noticed that two small bunds each contained approximately 15 litres of sodium bisulphite. A leak was found on the dosing pumps.

There was no fixed gas detection installed in the dosing pump room.

As a result of the leak, the dosing pumps were both mechanically and electrically isolated and also locked-off. The spillage was diluted with water, the area cleaned and permission was obtained for the diluted solution of sodium bisulphite to be flushed into the local sewer.

[testing inadequate, commissioning]

Lessons

The following recommendations were made:

1. It is not acceptable to a commission plant and allow it to continue operating with essential safety equipment missing, or inoperative. Such equipment is not an optional extra, but a pre-requisite to being legally permitted to operate the plant or process.
 2. Where defects are identified as a result of commissioning, or subsequent operation, safety critical defects need to be clearly identified and rectified promptly. It would be useful if safety critical items could be distinguished from minor snagging items to enable prioritisation.
 3. Where it is not possible to achieve either of the above, alternative arrangements need to be put into place which achieve an equivalent standard of safety and arrangements made to communicate these clearly to all staff. Specialist advice should be taken in these circumstances.
 4. In all cases, staff training provided for new processes and plant must include relevant health and safety items and, in particular, the hazards of the materials involved. This again is a fundamental legal obligation.
-

6310 21 November 1993

Source : THE CHEMICAL ENGINEER, 1993, 25 NOV.

Location : Haifa, ISRAEL

Injured : 0 Dead : 0

Abstract

Three gas leaks in pipeline serving a chemical complex from a refinery. Poor maintenance and corrosion were blamed for this incident.
[maintenance inadequate, gas / vapour release]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Transportation. Diesel oil spill at a refinery. A spill of low sulphur diesel oil was discovered off-site while product was being transferred via a pipeline. Gasket failure on the pipeline and possible improper installation of the gasket were immediate causes of this incident. The basic cause was insufficient inspection activities as service life of gasket extended.

Product loss, clean-up cost of gross contamination, soil disposal, investigation for an estimated \$75,000 (1993).

[material transfer, installation inadequate]

Lessons

Where the integrity of off-site operations cannot be monitored, the value of quick, effective emergency response cannot be understated.

6267 21 October 1993

Source : OIL AND GAS JOURNAL, 1993, 15 NOV.; HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1994, FEB.; EXECUTIVE NEWS, 1993, 1 NOV.

Location : Nanjing, CHINA

Injured : 0 Dead : 2

Abstract

Workers neglected level alarms during mistaken filling of a 10000 cum (cubic metre) storage tank resulting in overfill with gasoline and spillage into an adjacent drain channel. Spillage ignited by tractor giving fireball. 100 tonnes of gasoline caught fire. Fire attended by 10 fire brigades and took 17 hours to extinguish. Fatality.

[overflow, fire - consequence, operator error, loading]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

An operator was injured when decomposition gas (including carbon monoxide) was released from a seal pot on a weak acid scrubber, part of the gas clean-up system for anhydride units on an acetyls plant. The operator was attempting to re-make the seal when the gas was released. He felt nauseous and was taken to hospital.

The building was evacuated. One operator had continued working, unaware of the changing situation. He was safely located.

There were known to be process problems, associated with a furnace, which lead to an increase in the amount of decomposition gas produced. The actual state of the seal itself and of the scrubber units generally, prior to the incident, are unknown. In addition, there is no evidence of regular maintenance on the scrubber system.

An enquiry team investigated the incident.

[gas / vapour release, evacuation, maintenance inadequate, injury]

Lessons

A number of recommendations were made. These included:

1. A review of the use of (and type of) breathing apparatus.
 2. A review of Operating, Emergency and Safety Procedures to ensure suitability for use.
 3. Personnel training to include for the dangers associated with gases and vapours.
 4. An investigation into the integrity and operability of the scrubber system and seals.
 5. COSHH assessment/risk assessments associated with the decomposition gas and the scrubber seal to be undertaken.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

Steam pipe failure due to water hammer. Upon opening a steam valve, inside a pit, the valve failed from the force of the water hammer. There was some equipment damage. It was found that the valve was opened too quickly to allow the system to adjust, and a confined work space restricted action. In addition the cast iron valve was not strong enough to withstand water hammer.

Contributing was the unsuccessful use of a reach rod to open the valve, this caused the operator to fall into the pit. The basic cause was lack of written instructions for performing this task, and the operator had received no training or instruction. In addition the valve was not in a place easily accessible, and the material of construction was not a suitable material for steam valves, which are always liable to be affected by water hammer.

[damage to equipment, faulty instructions]

Lessons

Operating team as a whole needs to be aware of the hazards of water hammer in steam mains.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Reformer reactor flange fire at a refinery. During start-up of the reactor, after a small fire on the inlet flange, yet another fire broke out, this time on the bottom flange of the same reactor. It was found that the flange bolts were not secure. The basic cause was the absence of procedure for torque wrench tightening of bolts on reactor vertical flanges and inadequate inspection of flanges.
[fire - consequence, reactors and reaction equipment, refining, bolts incorrectly tightened, inspection inadequate]

Lessons

Flange bolt tightening techniques need to be correctly done, appropriate to the temperature range of the system from start-up to operating conditions. Flange bolting can be loosened during heavy rainfall; e.g., flanges or fittings with the shanks of bolts exposed can be particularly vulnerable.

6198 23 August 1993

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1993, OCT.

Location : Alexandria, EGYPT

Injured : 70 Dead : 1

Abstract

Powerful explosion in oil storage tank at refinery. Suspected incorrect leak test procedure. Fatality.
[testing inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Following an emergency shutdown due to instrument air failure, an explosion occurred during attempts to relight the furnace of the Crude Fired Heater. There were no injuries to personnel, but damage to the furnace roof and duct work was extensive.

Environmental impact was minimal as was public exposure. The total incident cost is estimated to be \$8.2 million (1993), including \$5.8 million (1993) of production losses and maintenance and other costs of \$2.4 million (1993).

The crude unit heater was repaired and back on stream on September 21, 1993.

The basic cause of the explosion was a failure of the operators involved to follow established safe isolation and start-up procedures on the fired heater. The haste to relight the furnace, to prevent shut down of the FCCU and related equipment, resulted in the failure to satisfactorily isolate the fuel gas during the purging stage and to carry out a proper gas test of the heater's atmosphere, before introduction of the lighted torch.

It is considered that the provision of functional pilot burners would have prevented the flameout, eliminating the need for a re-light of the furnace.

[damage to equipment, isolation inadequate, operation inadequate]

Lessons

The following recommendations were made:

1. There are no short-cuts in lighting/relighting fired heaters if safety is to be ensured.
 2. Standard procedures must be followed rigorously.
 3. Operators must be trained and made aware of the hazards involved in not following safe practices.
 4. The provision of pilot burners/flame out detection needs careful assessment for individual fired heaters, and where the decision is taken to install, these facilities must be in good working order at all times.
 5. Operators need to be adequately trained in the use of gas testing instruments, particularly in the limitations of the instruments as well as at what locations on equipment gas tests are to be carried out. Gas testing instruments require routine checking as to their being in working order and giving correct readings (calibration tests).
-

Source : LOSS PREVENTION BULLETIN, 115, 7-8.

Location : ,

Injured : 1 Dead : 0

Abstract

This incident occurred as an operator was setting up a rail tanker for unloading. The car was pressurised to about 20 psig (1.38 bar), an expected condition that results from the final leak test for the supplier. Following the standard company procedure for top unloading, the operator verified that the valve stem on the liquid line appeared to be in the closed position. The operator then cracked the cap of the liquid line while listening for any evidence of pressure. The operator heard no hissing, which indicated to him that there was no pressure in the line, and continued to turn the screw cap. As he reached the last turn the pressure blew off the cap and butyl acrylate discharged from the line, splashing him.

[spill, safety procedures inadequate]

Lessons

An investigation of the accident revealed that, the company procedure did not require the pressure on the car to be relieved through the vapour line before removing the liquid line cap, and that the valve did not have clear markings on to indicate whether or not it was closed, and the orientation and configuration of the valves were different on different rail cars. This led to an inability of the operator to reliably confirm that the valve was closed.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Vacuum residue tank roof to shell seam failure at a refinery.

An atmospheric tank containing vacuum bottoms overpressured, releasing material into the immediate area and the community. There were no injuries. Previous damage to the tank roof went unfixed and was viewed as "normal" by operators.

Total dollar losses were in excess of \$200,000 (1993).

The temperature of the product elevated due to pluggage of vacuum unit box cooler and the tank roof was damaged, possibly admitting higher oxygen content.

It was found that there was insufficient knowledge as to the safe operation of heavy oil tankage, and the tank used in a way other than that for which it was designed, it was used

beyond its design capabilities, and there was insufficient monitoring/observation of cooler while changes were being introduced.

[overpressurisation, refining, storage, damage to equipment, design inadequate, human causes]

Lessons

1. Rundown temperatures of residue to storage must not exceed safe levels.
 2. Damaged tanks retained in service may exacerbate problems at a later date.
 3. Temperature indications for storage tanks are usually poorly provided, giving operators limited reliable information. This needs to be considered when working close to safe temperature limits.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

High temperature corrosion in piping dead legs. After start-up of a crude distillation unit, smoke was seen coming from an uninsulated flange. It was found that a valve had failed due to internal corrosion. The basic cause was inadequate monitoring of dead legs, and the removal of unnecessary dead legs from service.

[valve failure, maintenance inadequate]

Lessons

The existence of process piping dead legs presents hazards which must be recognized and addressed.

Source : OIL AND GAS JOURNAL, 1994, 5 SEP.

Location : , VENEZUELA

Injured : 0 **Dead :** 0

Abstract

Accident in refinery caused by human error shut down catalytic cracker
[plant shutdown, operator error, cracking]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

DHT compressor explosion and fire at a refinery. An explosion and fire occurred at a reciprocating recycle H₂ (hydrogen) compressor during commissioning of a new DHT Unit. It happened during the reactor presulphiding step, when the recycle gas contained 9000 ppm of H₂S (hydrogen sulphide) and the pressure was at 940 psig. Failure of retaining bolts on head-end suction valve unloader of recycle cylinder on compressor allowed release of process gas.

Investigations revealed that the bolts failed due to inappropriate material (to prevent sulphide stress cracking) and inadequate design for the service. The manufacturer did not comply with the company's practice for reciprocating compressors in H₂S applications.

Estimated at \$100,000 (1993). Damage to compressor shelter, instrumentation. Estimated 250 manhours spent on investigation.

[fire - consequence, damage to equipment, design inadequate, refining, incorrect material of construction, stress corrosion cracking]

Lessons

Standards in design control, purchasing, construction, and inspection and testing of purchased equipment, are essential to the safety of any process plant project.

Each group involved in a project, whether projects, contractors, suppliers, designers, procurement, manufacture, construction, etc. plays a key role in assuring the equipment's fitness for use.

All possible process conditions must be detailed in the specification for the purchase of equipment.

HAZOP studies must include all deviations from the design operating conditions such as shutdown, start-up, maintenance, and other activities such as the presulphiding process to check the adequacy of the design.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

At about 14.45 hours, refinery personnel were attempting to remove a 5 tonne overhead hoist from the top deck of a processing column by rolling it off the permanent support beam onto a lifting beam suspended from a crane. The job went wrong, and the hoist (also known as a tigger) fell from the suspended lifting beam onto the piperack approximately 50 feet below.

The impact damaged utility lines, causing emergency shutdown of processing plant.

The estimated losses are \$1.6 million (1993), made up of significant production loss, damage to the piperack, with possible further damage to processing plant as a result of the emergency shutdown.

The rigging crew had not carried out this particular job before, and there was no competent engineering supervision in attendance.

[damage to equipment, product loss, plant shutdown, lifting equipment, safety procedures inadequate, design or procedure error]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 116, 21.

Location : ,

Injured : 0 Dead : 0

Abstract

A magnetic drive pump used for mixing acid (70% nitric acid, 30% sulphuric acid) exploded. After a low level pump shut down, an operator went into the plant and started the off-line pump, which he did not see was blocked in. Upon returning to the control room, he observed the acid tank level to be still low. He called another operator in the plant to restart the acid pump. The second operator started the on line pump and did not notice that the off line pump was still running. There was an explosion in the off line pump.

[operator error]

Lessons

After investigation the following main causes were found:

1. The mixed acid pump was run against a dead head until it failed 11 minutes later.
 2. Operator error.
 3. Management of change procedure failure, a project to repair a flow switch to automatically stop the pump on 'no flow' had not been completed.
 4. Maintenance pump running lights were not working.
 5. Equipment identification, both pumps and start buttons were poorly identified.
-

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A fire occurred in a bitumen storage tank. When an inlet valve to a bitumen tank was opened to release pressure build up in the header fill line, a rapid fire and minor explosion immediately occurred in the tank. Failure of the inlet line heating control system resulted in material heating up above temperature; and a non-standard part had been fitted to the system, rendering the trace heating control inoperable. A contributing factor was excessive air entering the line as a result of railcar off-loading.

The cause was operators not fully understanding the need to control temperatures of lines manually, and a non-standard part being used in the maintenance of the trace heating, without authority. Also the monitoring of procedures was inadequate.

[control failure, high temperature, high pressure, operator error, design or procedure error]

Lessons

There is a long history within the bitumen industry of the hazards of overheating bitumen storage tanks. The margin between necessary operating temperatures and those at which "cracking" of the product, combustion of tank deposits, etc. occurs can be very small with certain grades. A good understanding of this and adequate facilities for heating control and temperature indication are essential.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A fire occurred during stress relieving at a refinery. During a heat treatment operation, to stress relieve new welds on the debutanizer column, a small fire, followed by a flash fire occurred in a bulk-head compartment. The immediate cause was poor combustion and inadequate purging. The basic cause was failure to recognise conditions

[maintenance inadequate, fire - consequence, refining]

Lessons

1. Gas burners connected into a refinery vessel require an equal degree of understanding and training to that which is imparted to operators for dealing with fired heaters.
 2. Contractors left to their own devices, without a degree of supervision from the site,
 3. Have a significant potential for harm. Experience shows that even well established
 4. Contractors do not always have the expertise that they claim to have.
-

Source : ICHEME**Location :** ,**Injured :** 0 **Dead :** 0**Abstract**

An explosion and fire occurred in the pipe alley of a Vacuum Distillation Unit. The incident was caused by the freeze-up and subsequent failure of a 2 inch carbon steel pipe which released a high pressure spray of light hydrotreated naphtha towards the vac furnace and transfer line, where it ignited. There were no injuries, environmental impact was minimal. Total cost of the incident is estimated at \$14 million - \$10.5 million in production losses, the remainder in maintenance and associated costs.

Affected units were shutdown during the incident and recommissioned on the 24th March.

The failed line had been taken out of service approximately 20 years before, but had never been fully isolated or decommissioned. The piping acted as a large pocket or "dead leg," allowing water to accumulate. As the result of an extreme cold front on the 19th February, the trapped water froze, expanded, and cracked the pipe. During a subsequent warm up of the weather the next day, the ice plug melted, releasing hydrocarbon.

[fire - consequence, mechanical equipment failure, gas / vapour release, isolation inadequate, weather effects]

Lessons

1. Process piping deadlegs and lines in intermittent service should be identified and a program implemented to remove or safely manage them.
2. Fire proofing valves for certain services (e.g., fuel gas) will eliminate addition of fuel in fire situations.
3. Wherever possible, avoid flanges with "exposed bolts" which are subject to rapid failure under fire conditions.
4. Aluminium cladding on pipes/vessels, over insulation, gives only a very short time exposure under fire impingement.
5. Remote shutdown facilities for pumps on critical auto-start are required to allow over-ride in fire situations, to avoid adding fuel to fires.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A flashback occurred in the fired heater of a Furfural Extraction Unit (lube oil treatment) at a refinery. Two operators were under the heater at the time of the incident, but they escaped without injury. There was no damage to plant. The unit was out of production for 3 hours, but as the extraction capacity was not a bottleneck, effective production was not lost.

The immediate cause of the incident was too rapid a change made by the operator (under manual control) to the fuel oil supply to the heater.

The underlying cause was some deficiency in operator training.

[explosion / pressure release, operator error, training inadequate]

Lessons

The report stated the following recommendations:

1. Operator training to include study of precautions needed in taking instrument control loops onto manual, in respect of affects this may produce on process.
2. Review means of escape from heater firing fronts, especially where these are "boxed in" with acoustic panels.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Approximately 12 tonnes (14,500 l) of white oil escaped into the bunded/diked area of a tank farm from an open drain valve during the filling of rail cars with white oil. The site's vacuum truck was used to recover the majority of the spillage, but some of the contaminated earth in the tank farm area had to be excavated and removed off site as special waste. The total loss was estimated at \$32,000 (£19,200) (1993).

Product from storage tanks is transferred by means of screw pumps to a hose station/manifold. From the hose station/manifold, cross connections can be made from various storage tanks to a considerable number of filling lines, by means of flexible hoses. The filling lines are either dedicated to specific products or product groups. There are no dedicated lines available, however, for different grades of white oil to be loaded. In order to avoid contamination between grades, each filling line is cleared of the previous grade by means of a pipeline pig. At the end of the pigging operation the pig rests in the pig launcher/receiver at the hose station/manifold. The launching/receiving chamber has a mechanical device fitted for determining whether the pipeline pig is actually in the chamber. The chamber is simply a 4 inch "T"-piece, installed vertically and with a side entry for the product. The lower end of the T-piece is closed with a bolted blank cover and houses the pipeline pig, whereas the upper end is connected to the filling line. The end cover below the pig carries a three quarter inch nozzle, to which another T-piece is connected with ball valves at either end, one for depressurizing/draining the system and the other for supplying pigging air. The drain line terminates in a 2 inch header, which collects rain water from dripping pans and is connected up to a sewer box. The sewer box has a level-controlled (start/stop) pump fitted, which transfers any drain water to one of the oil interceptor pits upstream of the effluent treatment plant. The pigging air valve is only opened when the pigging operation is going on. However, the drain valve is kept open during filling. This means that the pipeline pig must have a tight fit in the launcher/receiver, as it is the only means of isolation between the product transfer at approximately 6 barg and the draining system. The operation was not designed this way. The system was installed some 15 years previous, and there had been difficulties during the transfers with the drain valve closed. This resulted in the pipeline pig rising in the piping, restricting flow. Someone then had the clever idea to leave the drain valve open. This mode of operation, however, introduced the potential risk of product entering the drains in quantities in excess of the capacity of the system, should the pig fail to isolate the drain. In such a case the drain line would be back pressured and product would be driven back into the dripping pans and escape into the bunded/diked area. To avoid a repetition of this incident a full bore ball valve will be installed between the pig launching/receiving chamber and the product entry in order to keep the pipeline pig in its housing during product transfers and to obtain positive isolation between the filling line and the draining system.

[loading, contamination, product loss, management system inadequate, operator error]

Lessons

The following recommendations were made:

Operators must be made aware that any departure from normal operating practices require scrutiny through the Management of Change procedure.

All transfer operations should be subjected to periodic hazard analysis with appropriate employee participation.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Near miss on extraction unit at a refinery.

While operators were in the process of isolating burners, an explosion occurred in the heater box. The cause was improper adjustment of equipment while it was being operated, and insufficient operator training (insufficient knowledge).

[operator error, refining, heating equipment]

Lessons

1. Operator training to include study of precautions needed in taking instrument control loops onto manual, in respect of effects this may produce on process.
 2. Fired heater safe operation practices retraining required, e.g., use of remote "heat off" facilities, judicious operation of flue gas dampers, limitations on rate of change in firing, etc.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Fire on vacuum distillation unit at a refinery. A release of a high pressure spray of light hydrotreated naphtha towards vacuum furnace and transfer ignited, resulting in explosion and fire. The spray came from "dead leg" line taken out of service 20 years previous. Extremely cold weather allowed trapped water to freeze, cracking the pipe, warm temperatures the following day caused ice plug to melt, releasing hydrocarbon. Failed line had never been fully isolated or decommissioned.

Losses; total \$14 million (1993), including \$10.5 million (1993) in production losses.

[weather effects, refining, fire - consequence, maintenance inadequate]

Lessons

1. Process piping dead legs and lines in intermittent service should be identified and a programme implemented to remove or safely manage them.
 2. Process hazard analysis should include reviews of isometric drawings and a physical survey of piping in the units.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Fire at waste gas incinerator. A small fire developed on the waste gas incinerator of a Fluid Catalytic Cracker Unit (FCCU) complex. Shortly thereafter, a gas cloud escaped through the incinerator's explosion doors. The immediate cause was product carry-over that created a fire hazard, the basic cause was instrument alarm failure and suction filters of slop oil pump were blocked. Contributing was the incorrect execution of VDU start-up. Damage repairs: \$137,000 (1993) (U.S.).

[fire - consequence, instrumentation failure, operator error, gas / vapour release, heating]

Lessons

Operational start-up procedures for units should consider possibilities of overloading/ carryover of hydrocarbons in effluent disposal streams to incinerators. Address how to avoid and what remedial actions are needed.

Slops disposal pump filters need regular attention and should be checked for cleanliness before unit startups.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Failure of belt press at a refinery.

Roller on belt press at waste water treatment unit broke, causing further damage to equipment. Failure of a weld on the stub shaft was the immediate cause and the basic cause was inadequate inspection of rollers when they were installed. The reconditioned replacement rollers were not "as good as new".

Losses: equipment replacement, repair, cost of maintenance, including expense of rental unit \$80,000 (1993).

[weld failure, installation inadequate, refining]

Lessons

If reconditioned rollers are purchased, proper inspection must be performed before installation.

124081993

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

A maintenance employee suffered severe injuries when the upper part of the split rims of a forklift truck tyre flew off while he was inflating it. The rim struck the man on the bridge of his nose and he needed extensive surgery to correct the injuries.

The maintenance employee received a spare wheel, which had been returned by an outside contractor who had repaired the tyre. The contractor had noticed that three of the five bolts were slipping during tightening. Hence, he did not inflate the tyre but marked the slipping bolts with chalk, and communicated this to the supervisor.

The victim, however, was given the wheel without being told about its state and assumed the wheel was ready for inflation. He did not check the condition of the rim nor did he torque the bolts before inflating the tyre. At 6.6 bar(g) the rim flew apart.

[safety procedures inadequate, injury]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 2 Dead : 1

Abstract

A marine transportation incident. Gassing incident during unloading of sour crude oil from a marine tanker. Two inspectors and one crew member were gassed during sampling/measuring of the ship's tanks. Protective equipment was not used in this hazardous atmosphere, and workers were not aware of the potential hazards of H₂S, hydrogen sulphide. Fatality.
[asphyxiation, safety procedures inadequate]

Lessons

With the introduction of inert gas blanketed cargo tanks, the latter no longer "breathe" on voyage; and, therefore, even small concentrations in the liquid space build up to high values in the vapour space. Exposure of personnel to this inert gas/H₂S mixture will produce rapid loss of consciousness leading to death. Rescue attempts should only be made when wearing the appropriate respiratory protection.

Source : ENVIRONMENTAL PROTECTION BULLETIN, 046, 28.

Location : , UK

Injured : 0 Dead : 0

Abstract

A road transportation incident. Two companies were fined £1650 and £300 (1992) costs after a vehicle was stopped in a random road check and was found to be carrying a number of 25 litre drums containing residues of acetone and lacquer, some of which provide inadequate containment for the waste. The company where they came from failed to provide a written description of the waste and failed to pre-notify the shipment of the waste.

[safety procedures inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

A forklift truck driver took a pallet from a 3 high rack. During this operation he pushed a pallet in the second row in an unstable situation. To correct this, all pallets of the first row were removed with the help of a second forklift driver.

In order to reach the unstable pallet he driver had to remove some loose wood and an empty pallet of the floor.

During this operation a form and fill foil roll fell down from the unstable pallet and hit the foot of one of the forklift drivers.

[operation inadequate, operator error, people]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

Preparation was in progress to isolate condensate sources to the acidic damaged Alky Condensate Flash Pot. An operator was in the process of switching from the turbine driven charge pump to the electric driven pump.

The operator checked the line-up for the pump, opened the discharge valve on the pump, and then started it. He then opened the isolating valve for the discharge pressure gauge. As he watched the discharge pressure increase, a hydrocarbon/acid release occurred from an open bleeder valve down-stream of the discharge pressure gauge. The operator was unable to close the bleeder valve due to icing and a large vapour cloud was released.

The operator returned to the control room to report the release and to put on a "D" suit. The operator in the control room activated the unit fire sprays and unit evacuation alarm, and reported the emergency over the radio. He also pulled the circuit breaker for the pump in the motor control centre and closed the electric operated EOV on the suction of the Depropaniser Charge Pumps.

The outside operator returned to the pump but was unable to close the valve on his first attempt due to the cloud in the air, the iced up valve, and that the front of his "D" suit was icing and restricting his vision. He returned to the control room, and the operator told him to try and close the pump discharge valve. He then re-entered the area and after climbing above the pump area to assess the situation, he was then able to close the main discharge valve on the pump and after the release stopped and the ice thawed the bleeder valve.

The maintenance leadman in the area saw the vapour release and used a water hose to knock-down the vapour, but as he was returning towards the pump alley the fire sprays in the unit were activated which pushed part of the cloud towards him. Retreating from the unit, and trapped in the cloud he inhaled some of the mixture. Emergency response was immediate, and oxygen was administered on the way to the Medical Centre. He was sent to hospital for chest x-rays, treated with Calcium Gluconate Aerosol and released.

The incident was under control in approximately 15 minutes, the electric driven depropaniser charge pump restored, and the unit returned to normal operation within about 2 hours.

The release volume was 2,700 lb of propane, isobutane, and hydrofluoric acid, the mixture containing 50 lb of the latter. No plant damage was caused by the incident.

[gas / vapour release, isolation inadequate, operational activities]

Lessons

The following recommendations were made:

1. Plug off all vents/drains when not actually being used.
 2. Ensure fire/drench water for dilution quantity is adequate for Alkylation areas to cope with re-leases.
 3. Review/retrain operators on pump start-up procedures.
-

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

An operator while removing a pressure gauge from a pipeline used to sulphide the catalyst in the a tail gas treater, received a short exposure of hydrogen sulphide in sufficient concentration to cause her a brief loss of consciousness.

The operator did not wear respiratory protection to remove the gauge, nor did the standby operator who assisted her and raised the alarm. Aspects of the time delay in obtaining medical treatment for the first operator, who fortunately revived quickly, were less than desirable and the subject of an investigation.

During this investigation a number of other adverse features were illuminated, covering communication, procedures, training, and the design of the sulphiding system.

[people, safety procedures inadequate, design or procedure error]

Lessons

The following recommendations were made:

1. When breaking containment on hydrogen sulphide systems all safety procedures must be complied with and appropriate respiratory protection used.
 2. Rescuers/responders to a gassing incident must also wear respiratory protection.
 3. Persons rendered unconscious in gassing incidents, especially if hydrogen sulphide is involved require a period of medical surveillance after resuscitation to ensure that should a latter relapse occurs they can be further treated.
 4. Respiratory protection for different work situations, rescue and escape, and resuscitation equipment must be readily available to plant personnel, and in perfect working order.
 5. Communication and transport availability must be such that help for a gassed person can be obtained without delay.
 6. Training of personnel must stress the hazards of hydrogen sulphide, even for open air situations with expected low orders of release.
 7. Over-reliance on valves to "hold" on sour systems has caused many incidents, as has also the false belief that respiratory protection is not required on simple jobs on gas systems.
-

Source : LOSS PREVENTION BULLETIN, 116, 9-13; ASAHI NEWSPAPERS; LLOYDS LIST, 1992, 17 OCT.

Location : Sodegaura; Chiba, JAPAN

Injured : 8 Dead : 9

Abstract

An explosion and subsequent fire took place at an oil refinery following shutdown for catalyst replacement work. The accident occurred when the process was returned to operation and approached normal operating conditions. The lock ring, the channel cover and a few other small parts of the feed/reactor effluent exchanger burst apart throwing debris more than a hundred metres, followed by a simultaneous explosion of the spouted hydrogen and a subsequent fire near the heat exchangers. A few minutes prior to the explosion, a loud major emission of hydrogen arose from the vent and drain holes and other locations of the failed exchanger. During shutdown for catalyst replacement, the feed/reactor effluent exchanges, including the failed unit were not subjected to internal inspection. Fatality.

After investigation the causes of this accident were found to be:

1. The gasket retainer had not been replaced in spite of diameter reduction to such an extent that it could over-ride the gasket groove.
2. The grinding repair performed on the gasket retainer at the last maintenance shutdown in 1991 was not appropriate and made over-riding easier.
3. There were no technical standards for the replacement of the internal flange set bolts that took into consideration the effects of bolt wear on the force and deformation of the lock ring.

As a background to 1,2, and 3, above, it has been emphasised that there was no clearly defined role for management of equipment maintenance between the user of the equipment and its fabricator, who conducted in-shop maintenance. This resulted in inadequate technical judgement.

[inspection inadequate, refining, fire - consequence]

Lessons

On the basis of knowledge obtained through this investigation, the committee has recommended measures to prevent recurrence of similar accidents.

These are:

1. Users of the same kind of exchanger shall carry out inspection of the gasket retainer and lock ring and whether the gasket groove and relevant parts were subjected to repair in the past. This shall be conducted at next temperature/pressure down (by internal inspection, even if there are no plans for open inspection at the next shutdown). The most appropriate maintenance control of these items shall be made.
2. Users of the same kind of exchanger shall clearly specify role sharing for maintenance management when they place an order of inspection and maintenance to an equipment fabricator. This shall establish adequate maintenance organisations so as not to overlook any problems that could adversely affect safety.
3. Fabricators of the same kind of exchanger shall review existing criteria for replacement of the internal set bolts and shall make the results of the review available to users of the exchanger.
4. When conducting maintenance inspections, the exchanger fabricator shall clarify respective scope of work between the fabricator and the user so that the users are aware of their safety management responsibilities.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Hydrocracker reactor effluent pipeline failure and fire at a refinery.

A 6 inch outlet elbow of a first stage reactor effluent air cooler failed, resulting in a fire. There was some damage to equipment. The presence of aqueous ammonium bisulphide resulted in erosion/corrosion that caused the pipeline failure. The cause was inadequate inspection for the detection of general and localised corrosion.

[fire - consequence, inspection inadequate, reactors and reaction equipment, cracking]

Lessons

An adequate inspection programme to detect general and localised corrosion/erosion attack is essential, coupled with a good recording system for all findings.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A seal vessel was emptied and all lines into the vessel, flare stack, and pilots were spaded. Upon removal of the control valve, there was a rumble and explosion, subsequently followed by another rumble and explosion along with fire coming out from the opening where the control valve had been.
[fire - consequence, maintenance inadequate]

Lessons

1. Both the seal vessel and knock out vessel should be filled with water, and any hydrocarbons present floated off, before the line is broken.
 2. Operating procedure must include danger of sucking air into the system due to the chimney effect.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A contractor employee was struck and fatally injured by an all-terrain forklift truck while walking diagonally into a construction site access road. A blind-spot on the right hand side of the equipment when the fork lifts are in the lower position for travel. There were no flagmen to assist the equipment operator in travel. In addition pedestrians and mobile equipment were sharing a congested workplace and the area was noisy due to the construction equipment. Pedestrian walkways were not established in all areas where personnel travel. Fatality.

[safety procedures inadequate]

Lessons

1. A safety policy and/or safe practices procedure should exist that establishes guidelines for the use of mobile equipment in congested areas.
 2. A training programme, including refresher training, for construction workers should include awareness of dangers created by working in proximity to mobile equipment.
-

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

An incident occurred on a No. 2 acrylo plant in which an employee suffered a left inguinal hernia while assisting three other mechanics in lifting the top of the gear box back into place on the compressor.

The incident occurred when the person concerned and three other nitrile mechanics had been setting the vibrations probes and were setting the cover plate back on to protect the bearing from the rain.

The cover plate weighed approximately 170 lbs. and had an eyebolt in the top for lifting purposes. The four mechanics put a bar through the eyebolt and physically lifted the plate from the gear box to the bearing. The distance was about 4 ft. The height of the equipment made the lift a shoulder-high lift. Because of the weight and awkward positions to make the lift, four men were used. Two men were located on each side of the compressor supporting the ends of the bar. As the cover plate reached the compressor, the men had to change their grip on the bar. At this point, the plate dropped down slightly.

An investigation into the incident found that the injury occurred due to the awkward position necessary to lift the cover plate back in to position necessary to lift the cover plate back on to position.

[safety procedures inadequate, maintenance, injury]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Shutdown of alkylation unit at a refinery.

Operational problems were incurred because of poor feedstock quality. The immediate cause was foaming and reduced acid concentration in alky plants because of high concentration of C5+ hydrocarbons in feedstock (reactive chemical). Inadequate testing of feedstock by shipping end was the basic cause. Losses: maintenance and materials \$52 000 (1992) production loss \$163 000 (1992).

[testing inadequate]

Lessons

1. Changes in feedstock composition may have wider ramifications on processing plant than is first apparent.
 2. Operators should be aware that excursions from design parameters may result in rapid corrosion/erosion in certain processing plants and steam raising systems.
-

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

An operator fell through a grating which slipped from its supports on the outfall basin. She received injuries to her shoulder and hip from the 9' fall into 2' of mud and silt.

The day before, an operator was working at the outfall basin. When he stepped on a grating near the stairway, it fell into the basin. He was able to catch himself by grabbing hold of the rail.

A 'Near Miss Report' was filed and a request made to repair the grating. The walkway was roped off at the head of the stairway to prevent entry. However, it was not roped off to prevent entry from the opposite end of the walkway, and a written request was not filed.

Before repairs were made, the second incident occurred. The operator and the subsequently injured operator had been doing routine skimming of the guard basin at the outfall creek. A trash pump was being use to suck oil out of the skimmers. When the operator went to open vents on the pump, she fell through a different grating into the outlet compartment of the guard basin. She fell approximately 9', landing in 2' of mud and silt.

The other operator, by laying down on the grating, managed to reach down and pull her up.

After showering and treatment by the shift nurse she was sent to hospital.

The grating was found to be supported by a concrete lip on one side (wider than 6"), and a metal channel approximately 1 1/2" wide on the other side. There was sufficient movement between the toe plates for the grating to slip off the narrower support.

[fall, safety procedures inadequate, injury]

Lessons

All personnel should be vigilant in identifying potential safety hazards. Once identified, it is critical that a response is made in a timely fashion.

A verbal work request should be followed up by a written work order; however, with the high level of activity in a total plant shutdown, a response to even a written work order may not be expedited in a reasonable time. It is, therefore, essential that temporary 'make safe' measures are taken - e.g., for this incident all means of access should have been roped off, instead of at the one end of the walkway only.

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

An operator went to carry out a gas test at the feedline on a tower. The feedline discharged into a low pressure flare gas header.

The gas test was required to allow a hot work permit to be issued so that flash assisted pictures could be taken of the flange facings of the lines connected to feedline. The pictures were required for investigation of an incident which occurred earlier in the day at the same location. There was scaffolded access platform beneath the safety valve.

A work permit issued by the chief operator of the unit to maintenance to remove the safety valve, required that air supplied breathing apparatus be worn for this job. Two maintenance contractor's pipefitters were on the scaffolding with air supplied breathing apparatus had removed the safety valve.

The operator climbed the scaffolding to take the gas test, he was not wearing air supplied breathing apparatus. Before he could fully perform the test he was overcome by gas, suspected to be nitrogen emanating from the open flare line. He backed away, turned and slumped to his knees.

He was disoriented and briefly lost consciousness.

One of the pipefitters grabbed the operator to prevent him falling under the scaffold guardrail. After one to two minutes the operator felt better and was assisted to ground-level by maintenance personnel.

He was forcibly given fresh air, later oxygen, and taken to the nurse's station. Shortly afterward he was taken to hospital for examination. He was released and sent home that evening.

Conclusion:

1. The gassing of the operator was due to inhalation of low pressure gas, primarily nitrogen, which had entered the section of flare system involved inadvertently.

2. The operator should have been aware and followed permit restriction regarding requirements. further, he did not use sound judgement in entering a potentially hazardous area with only minimum protection.

[testing, safety procedures inadequate, people]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A rail transportation incident. An LPG loading hose pulled free of a rail tanker liquid fill valve shortly after loading commenced. The resulting spill ignited. When loading began the connection began to leak, and when an operator tried to close up the leaky connection, the coupling gave way and blew out. Examination of the steel coupling revealed flattened and damaged threads. In addition the operator had only been with the company for 6 months and had no previous operating experience and did not follow guidelines for loading LPG railcars.
[operator error]

Lessons

Perform regular inspection of hoses, couplings, bonding systems, etc. Adequate provision should be available for safe shut down of LPG systems without presenting hazards to personnel.

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

Gassing incident. An operator, not wearing protective equipment, was overcome by gas while he was performing a gas test. It was found that a nitrogen valve leaked when pressuring up the feed system. The employee did not clearly understand the requirements of the job.
[operator error, management system inadequate, testing]

Lessons

Personnel must abide by instructions given on need to wear respiratory personal protective equipment (PPE), and must ensure that the correct type is used. The hazards of nitrogen, i.e. the rapid effect it can have on the respiratory system, needs regular reminding to personnel.

124001992

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A worker was killed during welding operations. A new pipeline was being installed and as a result of heavy rainfall the previous night, the soil was saturated with water. A corrugated metal sheet was placed on the ground for the welder to lie on his back when welding the lower part of the pipe. After being given a new electrode, he was heard to say that he had suffered an electric shock. His head was seen to fall back and the workers around immediately dragged from under the pipes. He was still breathing and was given first aid and then transported to hospital but was pronounced dead on arrival.

An investigation into the incident revealed that the welder's clothing and gloves were wet from the contact with the surroundings and his perspiration.

[electric shock, fatality, safety procedures inadequate]

Lessons

[None Reported]

108571992

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

An explosion occurred whilst an electrician was testing for central voltage with a hand-held tester. The incident occurred when the tester was connected to a 2400 volt line, it exploded, because the tester was designed for only 600 volts.

The electrician received electrical shock and burns on his hand and fingers, and he required medical treatment. There were also equipment and material losses. Even though the actual losses seem small, the potential existed for life threatening injury, electric shock significant equipment damage, and, even, disruption of process.

The immediate cause was improper use of equipment, a tester designed for 600 volt lines was connected to a 2400 volt line and insufficient knowledge of the potential hazards. Contributing to this incident was a failure to follow procedures to check electrical ratings prior to beginning work.

[damage to equipment, electrical, design or procedure error, safety procedures inadequate, injury]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

An employee of a roofing consultant fell through an asbestos sheeting section of a bitumen blending shed while walking on the roof and landed on the concrete floor 7.5m below. The workman was replacing hail-damaged fiberglass sheeting with new sheeting. At the time of the accident, the weather was fine, dry and sunny with moderate winds.

The man died where he fell, a short time later.

An in-house investigation was carried out. All persons involved in the work activity and the incident were interviewed and statements taken.

The immediate cause of the accident was the failure of the contractor to use crawl boards as specified in the Fire and Safety Certificate, and as defined by legislation.

[contractor error, fatality, repair, fall]

Lessons

1. Contractors have a safety plan for the work to be carried out, and it must be adhered to.
 2. Ensure that all the company and contractor's supervisory staff and employees understand the Work Permit System.
 3. Ensure that company employees understand the responsibility placed on them with regard to enforcing safety requirements.
-

108561992

Source : ICHEME

Location : ,

Injured : 3 Dead : 0

Abstract

Two mechanics and one radiation specialist contractor were exposed to radiation during maintenance on a nuclear density gauge. This was a result of the source not being completely stowed in housing while the maintenance work was being performed.

The immediate cause of the incident was that the equipment used for raising and lowering the nuclear source had failed due to misalignment. However, the underlying cause was that there was insufficient knowledge of the potential hazards related to this type of work. Contributing to the incident was the failure to conduct a radiation survey prior to beginning the work.

[maintenance procedure error, radioactive, operation inadequate, people]

Lessons

[None Reported]

Source : LLOYDS LIST, 1991, 24 DEC.

Location : Han-nan; Osaka, JAPAN

Injured : 2 **Dead** : 8

Abstract

An explosion occurred in an edible oil tank at an oil processing plant following worker's inspection of an oil crusher. Work on extraction vessel undertaken without regard to safety procedures for purge time, gas test or work permit issue. Fatality.

[reaction vessel, operator error, oil - edible]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

On Saturday, December 21, 1991, a sudden release into a isocracker compressor flare header destroyed a safety relief valve and damaged a sight glass on a liquid collection pot. A release of hydrogen rich vapor to atmosphere occurred, necessitating a shut down of the isocracker.

The damage was limited to that previously described, and there were no injuries. The isocracker was returned to service on December 25.

The incident cause was an accumulation of liquid in the flare header. The problem was compounded by undersized header and piping, and triggered by unstable operating conditions.

Additionally, deficiencies in the incident response procedures were uncovered.

Based on the investigation findings, recommendations have been made to review and revise procedures and to re-engineer the flare header.

In this incident the losses are limited to reduced production and repair costs; however, there was a potential threat to life and major equipment.

[gas / vapour release, plant shutdown, processing, draining of line insufficient]

Lessons

1. Drain drip pots frequently to prevent liquid build-up.
 2. Locate source(s) of liquid and remedy now, where possible, or during the shutdown.
 3. Ascertain any testing required for individuals exposed to high levels of noise or hazardous vapours.
 4. Redesign the liquid removal system to ensure no build-up.
 5. Redesign the flare header to reduce velocity and back pressure.
 6. Adjust the operating and emergency procedures to reflect the dangers of rapid feed rate changes.
 7. Review the maintenance requirements for compressor alarms and trips.
 8. Review the refinery quality control procedures for work done in outside workshops.
-

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A hydrogen leak occurred from a low temperature valve on an acetic acid plant. The leak ignited and the resulting fire burned for about an hour. There was considerable media attention, particularly from local radio. It was surmised that deterioration of the valves may have taken place shortly before the incident. [fire - consequence, maintenance inadequate, inspection inadequate]

Lessons

The need for efficient communications between shift staff and day staff was emphasised.

There is also a need for standards for operations and maintenance staff, detailing key routine tasks, including the frequency of plant inspections.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A magnetic flow meter in the instrument workshop, awaiting repair, ruptured with a loud bang and sprayed a foamy acid a distance 5-10 feet for 3-4 minutes. There were no injuries. The instrument had previously been sent to the manufacturer where they had noticed some liquid in the window of the electronic amplifier. A decontamination certificate was requested but they were told that it had been flushed out with water. On loosening the casing there was a hissing sound and acidic material came out. The valve was repacked in polythene and returned to the works by Friday evening and placed in the workshop. The meter ruptured on the Sunday. The cause of the pressure in the casing was hydrochloric acid reacting with the aluminium coil housing causing the generation of hydrogen. The path of the acid into the coil housing was past the gasket at one end of the meter spool piece between the meter flange and the process pipe flange. The acid behind the the PTFE liner of the spool piece and corroded the spool, created a path between liner and spool, and eventually entered the coil housing via the magnet pole pieces. The process ran at 2.5 bar forcing acid into the coil housing.

[hydrochloric acid, maintenance, repair, meter, environmental, spillage, contamination, maintenance inadequate]

Lessons

The following recommendations were made:

1. The wrong gasket was used which did not give enough sealing area and there was poor installation.
 2. The flange and liner overlap was not corrected, i.e., 1 inch flange-liner overlap for 1/2 inch flange on vendor supplied unit. This did not match the vendor's certified drawings
 3. Formulate a decontamination procedure and issue certificates for all equipment leaving the works.
-

5495 December 1991

Source : ENDS REPORT NO 229, 1994, FEB.

Location : Severnside; Bristol, UK

Injured : 0 **Dead** : 0

Abstract

Leak of one-third of a tonne of ammonia from ammonium nitrate plant occurred due to lower nitric acid feed not being noticed. Company fined £2000 (1991). Cause attributed to faulty instructions.
[gas / vapour release]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A pump seal leak on a booster pump started a fire causing shut down of the crude unit. Fire propagated into overhead equipment. Actual Losses \$5.5 million (1991) for equipment repair/replacement. It was found that no preventive maintenance had been carried out.
[fire - consequence, seal failure, maintenance procedure error]

Lessons

Motorised operating valve seal pressure switches for critical pumps e.g., hot oils or vaporizing liquids should be tested.
Perform vibration analysis on critical machinery.

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

A fitter fell 15 feet from a ladder and had to attend hospital to attend to his (unspecified) injuries. The fitter had been attempting to lift a jack (approx 30 kg) up the ladder using a loop of rope slung over the top of the ladder. The rope snapped and he lost his balance and toppled over the handrail round the platform. An enquiry concluded that the cause of the accident was intended method of lifting was unsuitable for such a heavy piece of equipment and that the rope used was not fit for the job.

[fall, safety procedures inadequate, injury]

Lessons

1. Handlines should be withdrawn from all areas of the site, visually inspected and discarded where necessary.
 2. There should be a review of the type of handlines used and controls put in place to cover their purchase, issue, storage and inspection.
 3. Manual handling training and re-training should be set up and documented.
 4. Contractors should be made aware of site guidelines on use/control of ropes/handlines.
 5. Calls for emergency services should request attendance at the main door of the building, where details of the exact location can be given
-

Source : ICHEME**Location :** ,**Injured :** 0 **Dead :** 0

Abstract

A regenerator was being opened for inspection, when flash fires erupted from within. The fires came out of the manways and isolation breaks in the piping circuit, and a pressure wave traveled through the plant. There was mechanical damage to the plant from flash fires and damage to the waste heat boiler, and to downstream piping and supports from the pressure wave. Combustion of methane, carbon monoxide, and hydrogen in the presence of Fluid Catalytic Cracker Unit (FCCU) catalyst caused the accident. The basic cause was insufficient knowledge on how thermocouples behave in steam fluidized and slumped beds of catalyst. This led to the belief that the temperature was low enough to open the vessel safely. In addition, emergency steam was introduced when air from the blower was lost.

There was no normal operational limitation on unloading temperature.

[fire - consequence, damage to equipment, competency lacking]

Lessons

1. If an air blower is lost, sufficient medium must be available to adequately purge the whole bed; use of nitrogen may not be practicable.
 2. Delay in introducing cooling air, and if steam enters the regenerator during this period, gives a risk of producing flammable gas.
-

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

Serious HF (hydrofluoric acid/hydrogen fluoride) burn at a refinery.

A metal burr on a blind being removed from pumps in the Alky Unit punctured a contractor employee's 'D' suit glove resulting in an HF burn to the finger. This accident was caused by wear and tear of protective equipment and insufficient maintenance procedures.

The cost of the investigation was \$1,552 (1991).

[design or procedure error, burns, maintenance inadequate, refining]

Lessons

1. Personal protective equipment must be maintained and inspected thoroughly prior to use in hazardous area.
 2. Consider using an HF resistant glove liner inside the alky glove.
 3. Maintenance personnel should be trained on the hazards of HF and the need to follow proper handling procedures of Alky tools and equipment.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

In November 1991, as a result of borehole measurements taken as part of the monthly subsurface oil monitoring program, it was discovered that the level of free oil on the water table had increased substantially. It was subsequently established that approximately 2390 litres of alkylate had been lost from a storage tank, from two failures in the tank floor.

The tank had been recommissioned on October 19, 1991, after a major overhaul.

The alkylate was lost to ground from the tank when the tank failed in two locations, 1m apart, at the lap weld between the 6mm floor plate and the 9mm annular ring. The failures were caused by severe localized wastage of the weld metal.

Such localized corrosion is not uncommon in tanks and, in this case, it was visually evident and should have been observed by the inspector in meeting the requirements of a major tank overhaul.

From the evidence, it is clear that the floor of the tank was never thoroughly inspected and yet the inspection report was subsequently signed and issued, and endorsed to the Year 2006 for the next thorough inspection of the tank.

[weld failure, inspection inadequate, spill, storage tanks]

Lessons

Make sure that appropriate line management actions are taken where there have been failures in carrying out responsibilities.

Review inspection and reporting procedures, incorporating forms and/or checklists as appropriate to ensure that a tank cannot be returned to service before they have completed their responsibilities.

Hydrotesting of tanks to be restricted to those tanks which have had major structural repairs or modifications as per the appropriate codes, i.e. neither practical or justified to so test all tanks returning to service.

Upgrading of the tank gauging system to be extended to cover intermediate tankage, so that all oil movements can be more closely monitored, and discrepancies identified immediately.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An operator was overcome by H₂S (hydrogen sulphide) while removing a pressure gauge on an acid gas line.

The cause was failure to wear respiratory protection when opening the line. The basic cause was insufficient motivation or knowledge of potential hazards.

Contributing to the accident were the design of the sulfiding line which was prone to plugging, and failure to follow procedures for unplugging lines. In addition there was no work permit system for line breaking.

[design or procedure error, operator error]

Lessons

1. H₂S personal monitor programme that addresses training, use, testing, calibration and maintenance should be established.
 2. Refresher training along with periodic task observation should be conducted to insure awareness of potential hazards and proper procedures.
 3. Testing of the Emergency Response Plan with periodic drills should be conducted to
 4. Insure issues such as communication and responder's roles are addressed.
 5. Work permit system must be used for all line breaking.
-

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

During a plant start-up, a plant superintendent was splashed with ethylene oxide whilst closing a drain valve on a reactor feed system. She developed a large blister and swelling of the foot and ankle. She was not wearing appropriate protective clothing. Although she used a safety shower to remove ethylene oxide from her overalls, she did not strip off contaminated clothing and wash thoroughly until about 1 hour later. She did not inform a First Aider.

The valve had apparently been checked shut (by two people) as part of start-up procedures: however it may have been jammed open (giving the impression of being shut). When an upstream block valve was opened, the leak of ethylene oxide occurred and the supervisor moved quickly to shut the drain valve to minimise the danger of fire/explosion.

[start-up, , isolation inadequate, safety procedures inadequate, reactors and reaction equipment, near miss]

Lessons

The large number of recommended actions included:

1. The blanking/plugging of open vents and drains on ethylene oxide/propylene oxide duty, and a survey for the need to do this on other similar chemicals.
 2. Better procedures for valve operation (ie ensuring that valves are not left 'hard open'.
 3. Improved awareness of the need for full protective clothing if dealing with loss of containment of ethylene oxide.
 4. Reinforcement of the correct decontamination procedures if splashed with ethylene oxide. Also the need to inform First Aider and note in Accident Book.
 5. Improved training in the correct action to be taken in the event of an accident.
-

Source : LLOYDS LIST, 1991, 31 MAY.; HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1991, JUL.

Location : Berre-l'etang, FRANCE

Injured : 15 Dead : 0

Abstract

A leak occurred on a 50 barg ethylene pipeline near a road where a vapour cloud formed. A vehicle stalled in the vapour cloud and then restarted which ignited the vapour cloud to give an explosion. A jet fire formed which impinged on an adjacent ethylene 60 barg pipeline and which ruptured. This in turn set fire to some rubber. An investigation found that the initial leak was caused by corrosion of a section of the line. The corrosion was some 15cm long at an area of damaged wrap.

[fire - consequence, inspection inadequate, maintenance inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A level sight glass on a HF (hydrofluoric acid) alkylation unit at the refinery failed while it was being pressurised for the purposes of testing the acid ratio, and some 750 litres of acid was released to the atmosphere during an incident that lasted 15 minutes.

Both operators immediately withdrew and ran to the alkylation unit control room and shut off the control room air purge system. They then started the water deluge system and triggered the traffic warning lights on the access road.

The remote controlled deluge monitor could not be seen during the period of the release, as the vapour cloud completely enveloped it. Later it was found to have not been directly trained on the source of the leak.

At its maximum the cloud was estimated to be 10 metres high adjacent to the leak source.

There were no injuries to personnel, however it is considered that if the incident had occurred during the day shift when more people might have been in the vicinity the results could have been serious. The emergency response to the incident was judged to have been very good.

The cause of the failure of the sight glass was improper maintenance assembly. Disassembly of the segment that leaked showed that it had been assembled in an incorrect order.

[gauge glass failure, installation inadequate, maintenance inadequate, gas / vapour release]

Lessons

1. To seek alternative methods for taking an acid ratio, for example the use of flow meters if possible.
 2. To review protective clothing requirements when using sight glasses.
 3. To investigate the design of sight glasses for alkylation units, and to determine if the use of Teflon gaskets is optimum.
 4. The location of air supply hose stations to be rearranged.
 5. To implement the alkylation task force recommendations as soon as possible, in particular, to relocate/duplicate the controls for the remote operated monitor, and to investigate provision of more fixed deluge sprays on the unit.
 6. To install air locks on the entrances to the alkylation unit building.
 7. To consider the provision of breathing apparatus in adjacent areas from which escape could be difficult resulting from an alkylation unit release.
-

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

During the start-up of a furnace system, about 4 tonnes of quench oil escaped to a local river due to a drain valve being left open.

The valve was piped to an oil/water separator intended to prevent gross contamination of the sewer by light oil. Unfortunately, because the density of quench oil is very similar to that of water, the separator was not effective and the oil went to the river.

The river board was notified, but no significant contamination was found.

[start-up, commissioning, waste water treatment, spill, pollution, operation omitted, design inadequate]

Lessons

The following recommendations were made:

Apart from the immediate measures to stop the escape of quench oil, an investigation was put in hand to prevent recurrence.

A design was to be developed to effect permanent modifications to the separator to handle quench oil.

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

An operator received serious burns when the bursting disc ruptured on a catalyst pot feeding a polyethylene glycol reaction vessel. The operators feet and lower legs were sprayed with caustic soda/ethylene oxide at about 140 degrees C discharged from a ground level vent. (The pressure rating of the disc was 10 bar, but it apparently failed below its design rating).

Following modifications to the reactor system some time before, it had been realised (late in the modification project) that under certain conditions it would be possible to overpressurise the catalyst pot. Operating procedures had been issued requiring the catalyst pot to be isolated (and valves padlocked) at a certain stage of the process. However these new procedures had not been formally authorised, and did not call for a signature to confirm that the isolation procedure had been completed. Other catalyst pots on the plant did not require these special isolation procedures.

An operator on the previous shift had set the reactor system up, but had failed to isolate the catalyst pot. This omission was noticed by the incoming operator, who was operating valves to remedy the situation when the bursting disc ruptured (although the catalyst pot appears not to have been overpressurised at this time).

[gas / vapour release, bursting disc failure, isolation inadequate, design or procedure error, safety procedures inadequate]

Lessons

The investigation team made the following comments/recommendations:

1. The modification project team failed to identify the possibility of over-pressurising the catalyst pot until just prior to commissioning.
 2. The 'locking out' system introduced to overcome the problem was inadequately written up and controlled.
 3. The location of the vent from the catalyst pot was not in a safe position.
 4. The bursting disc failed below the design rating
 5. The operator on the previous shift omitted to carry out the isolation of the catalyst pot
 6. The incoming operator felt that corrective actions were within his competence and did not require help from supervision.
- Specific changes to the system included eliminating the need to isolate the catalyst pot, either by upgrading the current equipment or providing a new updated pot. More general recommendations focused on improvements to training, operating procedures and the conduct of technical safety reviews.

Source : ICHEME

Location : ,

Injured : 0 Dead : -

Abstract

HF (hydrogen fluoride) Alkylation Incident. While maintenance was being performed to replace a seal on an acid circulation pump, the pump casing flange blew apart, releasing hydrogen fluoride acid and isobutane. A block valve on the system did not function as intended, and a key pressure gauge on the pump discharge line was not used. In addition maintenance work had begun before safe work permits had been issued. Incorrect assumptions were made about the readiness of the system, rather than checking/waiting for work permits.

[safety procedures inadequate, fatality]

Lessons

There is no substitute for the development, documentation, training and implementation of proper procedures at all levels.

Although design and proper operation are the most effective tools in preventing process related incidents, an experienced, well-equipped emergency response team is invaluable in mitigating the consequences of such incidents, including the proper management of government agencies.

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A crude unit operator fell approximately 20 ft from a piperack to the concrete floor below and sustained fatal injuries. The operator had climbed into the piperack, on his own, to open two closed 1inch steam valves. When he was within 10 ft. of the valves, he apparently placed his weight upon a 1inch insulated steam line which proved to be out-of-service and badly corroded beneath its insulation. The line broke and the operator pitched backwards, head first, to the concrete floor below.

The investigation report concludes that the basic cause of the accident is attributable to the absence of a safety policy and training program outlining the requirements for carrying out work at elevated locations, e.g., precautions and equipment required.

[fall, safety procedures inadequate, design or procedure error, fatality]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

An oil crude unit operator sustained a fatal fall from a pipe rack of 20 feet. The operator stepped on a 1" out-of-service insulated steam line that was badly corroded. The line broke and pitched the operator backwards, head-first into the pipe ally floor.

There was an absence of a safety procedures and training programme on elevated work procedures. Alternative entry equipment (e.g. ladders, scaffolding) was not available in the immediate work area. Failure of two ground level valves and the presence of corroded pipe concealed by insulation in the pipe rack caused this accident. Fatality.

[corrosion, safety procedures inadequate, operational activities]

Lessons

1. A safety policy and/or safe practices procedure should exist that governs the procedures and precautions to be observed when engaging in elevated work.
 2. A training programme, including refresher training, on the elevated work policy, practices and equipment should be required for all new and current employees and contractors.
 3. Ladders and safety harnesses should be permanently stored and made available in operating areas.
-

Source : ICHEME

Location : , SWEDEN

Injured : 0 Dead : 0

Abstract

A number of the originally open top floating roof tanks had been fitted with aluminium weather protection domes. The space below the dome was well ventilated to prevent vapour buildup.

During maintenance work on one of the gasoline tanks fitted with such a dome, it was discovered that four of the roof pontoon compartments contained product. After emptying the pontoons, cleaners and plant inspectors were allowed to enter these pontoons for cleaning and inspections for leaks.

They were exposed to remaining hydrocarbon vapours and suffered nausea, despite usage of personal protective equipment prescribed for work in the tank, they had to withdraw from the work. They recovered and returned to work the following day.

Subsequent investigation showed that there had been a mistake in applying the entry permit system, in that clearance had been given for the work going on above the roof (under the dome), but nobody had specifically checked the pontoons for any dangers that might be present.

[entry into confined space, personal protective equipment, cleaning, inspection inadequate,]

Lessons

There should be separate entry permission given for entry into the tank, for work between the roof and the dome, and for in the pontoons.

Source : ICHEME

Location : ,

Injured : 6 Dead : 0

Abstract

Release of propane and HF (hydrofluoric acid) from HF alkylation plant at a refinery.

During the start-up of the HF alkylation unit, an operator was exposed to a moderate dose of hydrofluoric acid vapours. Other operators responded and were exposed to a large release of propane and HF acid from a failed gauge glass on the depropaniser overhead accumulator water boot.

The size of the leak gave serious concern that ignition from the plant fired heater might occur, but the actions of the shift fire brigade and operators and a favourable wind direction prevented this.

Six personnel were exposed to vapours and required medical examination but fortunately did not develop lasting respiratory problems.

The primary cause of the release of HF was the inadequate design of a seal flush system from the No.2 Depropaniser to the Alky acid area.

There was inadequate use of respiratory protection by all responders, leading to exposure to HF.

The secondary, or more basic causes of the incident include various deficiencies with engineering, fire protection equipment, training, maintenance, and operating programmes.

[gauge glass failure, gas / vapour release, design inadequate]

Lessons

A number of recommendations were made:

1. Study of the seal flush system, eliminate possibilities of reverse flows.
2. Reflux pump low pressure alarm switch to be removed and checked for proper setting.
3. Develop a procedure for tagging nuisance alarms in all units to minimize interference with priority alarms.
4. To complete a 'job safety analysis' for responding to HF acid leaks and develop an emergency procedure, incorporate the procedure in the job training guide and qualification test for all relevant operators, train all supervisors on the procedure, review availability of personal protective equipment to meet procedure and practice donning emergency equipment.
5. Considerable improvements planned for the refinery fire brigade training, to include such training within job qualification tests, changes to content of drills to make these a tougher scenario, and strengthening the visibility of shift brigade leaders so that operators know who to report to, etc.
6. Ensure that HAZOP modifications are fully documented on the respective units in manuals, guides, etc., and to consider re-qualifying operators on units where extensive changes have been made.
7. Review adequacy, location and remote operability of fixed fire fighting facilities on Alky Unit, with particular reference to preventing ignition of leaks from Alky fired heater. Review provision and siting of portable monitors. Critical equipment should be identified for priority repair, ensure that fire equipment not available is logged in a suitable manner, improve routine testing of fire fighting equipment.
8. Standardise on monitor quick opening valves.
9. Investigate water supply adequacy in the Alky area.
10. Incorporate oxygen training within the Alky first aid training, to be part of the job qualification; ensure adequate "oxygen sets" availability.
11. Ensure that gauge glass cleaning on sour services is adequate, and review current operator compliance with requirements to blowdown gauges and operate gauge cocks.
12. Priority to be given repairing steam leaks in the Alky area.
13. Review staffing policy for startups and shutdowns.
14. Refresher training for operators as necessary on the use of Alky safety equipment.
15. Improve refinery call-in procedures and radio communications, that is, hardware and systems, and training in its use.

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

Fluid Catalytic Cracker Unit (FCCU) pipeline failure and fire. An 8 inch diameter gas oil line failed, releasing gas oil. During isolation of the line, a fire broke out. The failed pipe had been improperly welded.

Equipment damage/cost of repairs, \$850,000 (1990). Leak.

[weld failure, maintenance inadequate, fire - consequence, damage to equipment]

Lessons

Pipeline material and welding codes must be strictly followed, and adequate checks made to ensure that this is done. Any deviations must be subject to expert approval and be fully documented. Strict control on quality, storage, handling, and identification is required for welding rods.

Source : PROCESS ENGINEERING, 1992, JAN.

Location : Stanlow; Cheshire, UK

Injured : 0 **Dead** : 0

Abstract

The wrong valve was opened during routine maintenance causing a release of butane. An emergency valve was opened to burn the gas off through a flare stack. But a blockage in the pipework caused such a massive vibration that the whole piping system collapsed.

[gas / vapour release, excessive vibration, flow restriction, maintenance inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

Fire on a crude distillation unit. A rupture of the main process pipeline in the preheat section of the distillation unit resulted in a release of crude oil and a fire. There was significant damage to equipment. It was found that localised corrosion at the caustic injection went undetected and weakened the line. Contributing was an injection quill being inserted too far, the result being that caustic was being locally concentrated in the vicinity of the pipe wall. The cause was corrosion the result of recent plant changes involving the moving of injection point to a hotter point in the process, the impact of the change on the equipment was not addressed, and there was inadequate monitoring of injection points to determine the status of equipment.

[fire - consequence, inspection inadequate]

Lessons

Injection points for chemicals into process streams must be carefully designed and installed so that centres of localised stress corrosion are not created. Plant inspection programs should include monitoring of critical parts of systems where such corrosion might occur, with attention paid to "rate of change" thickness of walls to determine any unexpected increases in loss.

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1990, NOV.; LLOYDS LIST, 1990, 1 OCT.

Location : Zirku Island, UNITED ARAB EMIRATES

Injured : 0 **Dead** : 0

Abstract

A spill of 400 tonnes of crude oil occurred during loading operations. Valve at no 9 tank of the marine tanker was opened in error.
[operator error]

Lessons

[None Reported]

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1990, DEC.

Location : Lagos, NIGERIA

Injured : 0 **Dead** : 109

Abstract

Contaminated paracetamol syrup killed 109 children when diethylene glycol was deliberately labelled propylene glycol and sold to pharmacists. Fatality.
[deliberate acts, labelling incorrect]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

An incident occurred when leaking drums of acetonitrile were discovered on company premises. Company A had been contracted to receive four containers each containing 80 drums and to transfer the acetonitrile from the drums into road tankers for transportation to the works. They, in turn, subcontracted company B to destuff the containers and deliver the drums to them by flatbed lorry.

While gas tests were performed on each container, free liquid was found on the floor of the third container. Company A was informed immediately while employees of company B shut up the containers and sent them along a public highway to the premises of company A.

Company A contacted their employer to ask for advice and the work's plant superintendent was able to provide the necessary advice. The third container was opened by employees wearing full protective clothing and self-contained breathing apparatus. It was then deluged internally with water prior to the removal of the first row of drums, after which it was again deluged with water and a gas test done on the atmosphere inside the container. Once the gas test proved to be satisfactory, the second row of drums was removed and this carried on for the whole operation until the container was empty.

One drum was leaking from a pinhole in the bottom - the drum was inverted and placed inside an overdrum to contain the leak. The action was repeated on the other 3 containers. One empty drum was found. Although both drums appeared to be in good condition, the bottom end was badly distorted. When the empty drum was filled with water, the whole of the bottom seam was leaking.

Weights on the drums had not been checked and marking of product ID on the drums was not good.

The leakage from the drums was due to the drums being damaged before they were delivered to Company A. This could have been caused by the drums not being of a suitable standard for the carriage of acetonitrile or drums being mishandled when full prior to shipment. Further points could have had serious consequences:

1. Poor marking and labelling on the drums.
2. Reluctance of company A to deal with the incident which involved material they had handled previously.
3. Action of company B in knowingly sending container loads of leaking drums onto a public highway.

[containers, labelling incorrect, spill, transportation, material transfer]

Lessons

To prevent any future incidents:

1. Specify that only approved drums are used for the transportation of products.
 2. Instruct their suppliers on the correct handling of drums.
 3. Instruct their suppliers to mark and label drums in accordance with the IMO regulations.
 4. Ensure that suppliers of distribution services are safety audited before they are used.
 5. Ensure that suppliers of distribution services do not sub-contract work without prior approval of the contracting company.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A fire occurred on crude distillation unit. Release of naphtha ignited and started fire on distillation unit. A contributing factor was that it was a sour water system, and deposits were to be expected in valves. The immediate cause was an inability to close valve before work was begun, and there was no way to identify whether valve was closed. The basic cause was not being able to identified the hazard in preparation for work.

Losses, cost of repair and replacement, including demolition, \$14.5 million (1990).

[fire - consequence, valve failure, operator error]

Lessons

Where redundant pipework or vessels are to remain connected to a system, it must be done in such a way as to avoid dead legs/build-up of corrosive products.

5053 17 July 1990

Source : THE WASHINGTON TIMES, 1990, 18 JUL.

Location : Glenelg; Baltimore; Maryland, USA

Injured : 17 Dead : 0

Abstract

A chlorine gas cloud formed at a swimming pool when hydrochloric acid was accidentally mixed with chlorine. A correct label had fallen off or been removed from the can of hydrochloric acid and a hand written label that remained indicated the can contained chlorine.

[gas / vapour release, accidental mixing, labelling incorrect, operator error, containers]

Lessons

[None Reported]

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 3RD QUARTER, 1990.

Location : Duque De Caxias, BRAZIL

Injured : 0 **Dead** : 0

Abstract

An explosion caused a boiler to be destroyed in a refinery Fluid Catalytic Cracker Unit (FCCU) plant. Substance involved: fuel oil. Cause was instrumentation failure and operator error.

[refining, fluid cracker]

Lessons

[None Reported]

Source : CHEMICAL & ENGINEERING NEWS, 1990, 16 JUL.; LOSS PREVENTION BULLETIN, 102, 17-19; LLOYDS LIST, 1990, 7 JUL. AND 28 JUL.; HAZARDOUS MATERIAL INTELLIGENCE REPORT, 1990, 13 JUL. LOSS PREVENTION BULLETIN, 129, 12.

Location : Channelview; Houston, USA

Injured : 5 **Dead :** 17

Abstract

An explosion and fire occurred when a 900,000 gallon waste water storage tank ignited. The tank was used to separate water and hydrocarbons. The tank was nitrogen swept but failure of the system led to high oxygen level and ignition. Explosion occurred when workers were trying to restart a compressor which was used to remove hydrocarbons from the tank. Fire spread to 2 cooling towers and waste pits. Fatality.

[design inadequate, storage tanks, cooling equipment]

Lessons

The following corrective actions were taken.

Improvements to the safety system were made;

1. Oxygen analysers with separate sampling systems were installed wherever oxygen could be present; oxygen concentrations will automatically control the nitrogen sweep rate.
2. There will be a minimum nitrogen flow to maintain a safe oxygen level.
3. Nitrogen to be provided from two sources to assure a back up supply.
4. Hydrocarbon emissions to be controlled by flaring the vent gas. Using a pressurised waste water storage and dedicated flare will eliminate the need for a compressor.
5. Hydrocarbons to be stored with the waste water.

During plant reconstruction, all the plant process safety management systems were evaluated and enhancements made where necessary. These were:

1. In the utilities area, critical process safety operating parameters and variables have been identified for continuous monitoring by operators, supervisors and technical personnel.
 2. Preventative maintenance systems have been enhanced on process analysers and other safety critical equipment.
 3. All operating manuals and standard operating procedures have been reviewed, clarified and updated where necessary.
 4. Operators and technical personnel have received additional training on process safety, systems and procedures.
 5. Safety instrumentation, interlocks, process analysers and sample systems have been evaluated and tested.
-

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 2ND QUARTER, 1990.

Location : Tomsk; Siberia, USSR

Injured : 0 **Dead** : 0

Abstract

An explosion occurred in a new 300,000 tonnes per year ethylene cracker, one of four production lines. Major fire around fractionation area. The incident was caused by failure of a separation column where incorrect steels had been specified during the design phase.

[incorrect material of construction, mechanical equipment failure, fire - consequence, separation equipment, design fault, cracking]

Lessons

[None Reported]

Source : LLOYDS WEEKLY CASUALTY REPORTS 280/1

Location : Mutare, ZIMBABWE

Injured : 0 Dead : 0

Abstract

An explosion occurred when testing a new pulp storage tank. Tank filled with water when it ruptured damaging property and destroying tank. Test carried out with water as company believed that tank was not designed properly.

[design fault, storage tanks]

Lessons

[None Reported]

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 1ST QUARTER, 1990.

Location : New York, USA

Injured : 0 Dead : 0

Abstract

Transportation. 567 000 gallons of oil/diesel leaked into the local river. Company accused of not having leak detector system in operation. It is believed that a vessel hit the 12 inch 7 mile long pipeline. Spill.
[safety procedures inadequate]

Lessons

[None Reported]

4819 1990

Source : OIL AND GAS JOURNAL, 1990, 18 JUN.

Location : Eden Prairie; Minnesota, USA

Injured : 0 **Dead** : 0

Abstract

Failure of a check valve and connected high pressure tubing caused spillage of 75000 gallons of diesel fuel from a pipeline into a river.
[valve failure, safety procedures inadequate]

Lessons

[None Reported]

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 207 **Dead :** 0

Abstract

A rail transportation incident. During chlorine unloading from a rail car into the storage tank of the cellulose bleaching section of a plant, the steel-reinforced transfer hose burst, causing emission of chlorine to the environment. The storage tank was located in a closed building. Operators with suitable personnel protection suits closed the valves to stop the chlorine emission. The emitted chlorine was treated with caustic soda in the chlorine destroyer plant, and water curtains were used to wash out the chlorine. The population was warned and the rescue of injured persons was organised.

[storage tanks, gas / vapour release, overheating, design inadequate]

Lessons

1. Installation of quick-action isolation valves on loading/unloading parts of existing installations for toxic gases.
 2. More frequent inspections of similar installations by Authorities and experts.
 3. Use of hydrogen peroxide instead of chlorine for cellulose bleaching.
 4. Development of additional safety requirements for storage installations of liquefied toxic gases.
-

Source : CONCAWE REPORT 4/91

Location : , WESTERN EUROPE

Injured : 0 **Dead :** 0

Abstract

Transportation. The accidental closure by a pipeline workman of a main line valve at a pump station caused a scraper-pig trap at an upstream facility to be over-pressurized. A spillage of 252 cubic metres gross of jet fuel occurred. The pipeline was out of service for two days while the trap installation was modified. There was no significant pollution.

[overpressurisation, operator error]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A road transportation incident. A road tanker was filled with acetic anhydride and driven to the customer. On the way the tanker was stopped by a car and later a police car as a leak was suspected from the tanker. A small amount of product was found by the tank spill-box drain tube. All manhole clamps were checked and found secure and there was no leaks from the valves. He was permitted to drive on and delivered his acetic anhydride to the customer. There was no discrepancy in loaded and unloaded weights indicating a minimal loss. After unloading the tanker returned to the haulier for an inspection and check. On pressure testing it was found that the safe clamps which secured the manhole lid to the tank were leaking slightly and despite screwing the clamps tight there was still a leak from the front manlid. It was decided that the safe bolt adjusting sleeve was too deep to allow for compression of the packing ring and hence there was a slight leak. When the sleeve was modified a full sealing was obtained.

[spill, environmental, design inadequate]

Lessons

[None Reported]

4805 22 December 1989

Source : THE SUN BALTIMORE, 1989, 24 DEC.

Location : Queen Anne's County; Maryland, USA

Injured : 0 **Dead** : 0

Abstract

A road transportation incident. A road tanker overturned and ruptured a tank containing paint thinners. Driver was charged with drug usage.
[drug misuse]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A painter died after falling 40 feet when a scaffold suspension rope broke.

The victim was a member of a three-man crew engaged in the abrasive blasting and painting of the interior of a 48ft h x 30ft d steel water tank.

Three separate two-point suspension scaffolds were used to reach the interior walls of the tank. The scaffolds abutted each other in a U-shaped configuration. The centre scaffold platform was overlapped by one end of each of the other two scaffolds. Suspension ropes were located at each ends of the centre platform and at the outer ends of the two other platforms. The platform unit was raised by alternately raising each suspension point a few feet at a time. Two men were involved in this operation when the incident occurred. The victim was standing on an outer end of the platform and was pulling on the suspension rope to raise that end of the scaffold. He fell when the rope broke and his end of the platform dropped to a vertical position. The victim was not using fall protection equipment although it was available and being used by the second painter. Investigation revealed that the 5/8 inch nylon hoist rope had broken at a point where it had been burned some time before the incident.

[scaffolding, maintenance, material of construction failure, safety procedures inadequate, fatality]

Lessons

[None Reported]

Source : CHEMICAL HAZARDS IN INDUSTRY, 1994, JAN.

Location : Kenvil; New Jersey, USA

Injured : 12 **Dead** : 0

Abstract

Company fined \$6.3 million (1989) by OSHA for failing to take action on several health hazards after an explosion.
[safety procedures inadequate]

Lessons

[None Reported]

Source : LEES F.P, LOSS PREVENTION IN THE PROCESS INDUSTRIES, VOL3, 2ND ED., BUTTERWORT HEINEMANN, 1996, ISBN,0750615478.; OSHA, US DEPT OF LABOR REPORT TO THE PRESIDENT APRIL 1990; LOSS PREVENTION BULLETIN, 099; LLOYDS LIST, 1989, 25 OCT.; HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1990, MAR.

Location : Pasadena; Houston; Texas, USA

Injured : 100+ **Dead** : 23

Abstract

A massive and devastating vapour cloud explosion occurred in this polyethylene plant causing loss of life and extensive damage to plant with a force of 2.4 tonnes TNT. The accident resulted from a release of process gas during maintenance on a blocked reaction loop line. The instrument line to a shut valve was being connected when the valve opened and the massive release occurred. The valve actuating hoses were found connected the wrong way round.

Substances involved: isobutane, hexane, ethylene and hydrogen. Fatality.

[gas / vapour release, reaction vessel, maintenance inadequate, fire - consequence, isolation inadequate]

Lessons

The OSHA report details numerous defects in the management of the installation. Some of these are described below.

1. The company had made no use of hazard analysis or an equivalent method to identify and assess the hazards of the installation.
 2. Separation distances between process equipment plant did not accord with accepted engineering practice and did not allow time for personnel to leave the plant safely during the initial vapour release and that the separation distance between the control room and the reactors was insufficient to allow emergency shut down procedures to be carried out.
 3. The ventilation intakes of buildings close to or downwind of the hydrocarbon processing plants were not arranged so as to prevent intake of gas in the event of a release.
 4. There was a failure to minimize the exposure of personnel.
 5. The plant had no fixed flammable gas detection system despite the fact that the plant had a large inventory of flammable materials held at high pressure and temperature.
 6. An effective permit system was not enforced for the control of the maintenance activities.
 7. The sole isolation was a ball valve which was meant to be closed but was in fact open. There was no double block system or blind flange. The practice of not providing positive isolation was a local one and violated corporate procedures.
 8. The practice of relying for fire water on the process water system and the failure to provide a dedicated fire water system meant that the fire water system was vulnerable to an explosion.
-

Source : LOSS PREVENTION BULLETIN, 129, 12-13.

Location :

Injured : 0 Dead : 0

Abstract

A large flow of ethylene, the reactant, and isobutane, a catalyst carrier, was released from one of the high density polyethylene (HDPE) units at this chemical complex. The vapour cloud drifted northward toward the centre of the HDPE process area before ignition, which is believed to have occurred approximately one minute after the release. Seismograph data from recording stations in the area suggested the blast was equivalent to the detonation of 10 tonnes of TNT. The explosion destroyed two high density polyethylene units, which included a total of eight particle form, loop reactor trains. The heat from the explosion caused BLEVEs (Boiling Liquid Expanding Vapour Explosion) of nearby pressure tanks. Other process units at this chemical complex sustained only minor damage and resumed normal production within a few weeks of the incident.

The initial release of ethylene and isobutane occurred through an 8 inch ball valve on the No 4 settling leg of a reactor. The major function of this pneumatic valve is to isolate the settling leg and other downstream equipment from the reactor for maintenance. The company maintenance procedures for opening a settling leg included closing the ball valve, inserting a lock-out device into this closed valve and closing the block valves to the air hoses.

After the explosions, investigations indicated that the lock-out device had been removed from the valve and the air hoses had been reconnected to the valve operator on settling leg No. 4. The ball valve was found in the open position and the settling leg was open to atmosphere at the bottom of the leg where a swedge spool leading to the product take off valve should have been connected.

A business interruption loss in excess of \$700,000,000 (1989).

[gas / vapour release, processing, maintenance inadequate, damage to equipment]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A painter died when the platform he was working from fell 65 feet inside a municipal water storage tank. The victim was a member of a three-man crew that was using an improvised suspension scaffold to paint the interior of the 68ft h x 32ft d tank.

The scaffold consisted of an aluminium ladder used as a platform and secured to steel "stirrups" made of steel stock bar bent into shape and attached to each end of the ladder. Wire cables from each stirrup ran to a common tie-off point. A cable from this common tie-off was rigged to a block and tackle used from ground level to raise and lower the platform. The block and tackle supporting the system was secured to a vertical steel pipe on top of the tank with a cable that was fashioned into a loop by U-bolting the dead ends of a piece of wire.

The victim had been painting from one end of this scaffold while wearing a safety belt and lanyard attached to an independent lifeline. When the victim finished painting, he unhooked his lanyard from his lifeline and moved along the ladder platform to a position where he could hand his paint spray gun to the foreman (who was at the top of the tank). As the foreman took the spray gun, he heard a "pop" and saw the scaffold and the victim fall 65 feet to the floor of the tank. Investigation of the incident revealed that the two U-bolts on the loop of the cable supporting the block and tackle had loosened enough to allow the cable ends to slip through, causing the scaffold to fall. This rig had been used without incident every day for 2 weeks preceding this fatal fall.

[maintenance, storage tanks, fatality, scaffolding, fall, personal protective equipment, mechanical equipment failure, safety procedures inadequate]

Lessons

[None Reported]

4734 04 October 1989

Source : NEW CIVIL ENGINEER, 1989,12 OCT., 10,; LLOYDS LIST, 1989, OCT, 5.

Location : Edinburgh; Scotland, UK

Injured : 5 **Dead** : 2

Abstract

A fracture in a natural gas main, where it crossed a sewer, leaked gas into the sewer leading to the six storey tenement block, which was destroyed in an explosion when the gas ignited. Fatality.

[pipeline, pipe laying inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 1

Abstract

A contractor fell 28 metres from an upper level of a structure. There was no witness but it was thought that he had fallen through a hole in the grating at an upper level which had been barred off using scaffolding poles and a piece of rope. The investigation recommended that all holes to be more positively guarded and access to areas where grating had been removed must be restricted. Fatality.
[inadequate guarding, fall]

Lessons

1. Where gratings, floors or handrails are removed in a work area, the whole floor area should be treated as a restricted area and access only permitted by a work permit.
 2. Rope should not be used for guarding a hole in the floor
-

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

An operator fell four metres from the platform of a road loading gentry whilst carrying out preparatory work for offloading of a road tanker. The operator sustained back injuries and required hospitalisation.

An investigation concluded that the operator had stepped onto a loose fitting section of floor decking on the loading gentry, which then slipped off its supports, causing the operator to fall through the platform.

[fall, unloading, safety procedures inadequate, injury]

Lessons

The report stated the following recommendations:

1. Floor deckings on all offloading/loading platforms throughout the site to be inspected and repaired/redesigned as necessary to ensure safety.
 2. Operating tasks associated with the loading/offloading of different types of road tankers to be analysed to identify those areas where the safety aspects of carrying out such tasks need to be improved.
-

10531July 1989

Source : LLOYDS LIST, JUL 1, 1989, JUL 7, 1989.

Location : , USA

Injured : 0 Dead : 0

Abstract

A river transportation incident. A river tanker ran aground causing an estimated 800,000 gallons of fuel oil to spill into the river.

Diver inspections revealed cracks in the shell plating of two centre tanks and the No.1 starboard wing cargo tank.

The incident happened when an error occurred with the anchor mechanism causing the anchor to be dropped prematurely, thus causing the vessel to pivot and run aground. This operation should have been checked before the dropping of the anchor.

Forty per cent of the oil spilt was recovered.

[ship ran aground, mechanical equipment failure, operator error]

Lessons

[None Reported]

4615 23 June 1989

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, SEP.; HAZARDOUS CARGO BULLETIN, 1991, FEB.

Location : Off Newport; Rhode Island, USA

Injured : 0 **Dead** : 0

Abstract

A marine transportation incident. A spill of over 1,300 tonnes of oil occurred when a marine tanker hit submerged rocks. Cause: crew fatigue.
[operator/crew fatigue]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A fitter working on a container drilled through the wall and punctured a drum of propionic acid causing a spill.

[maintenance procedure error, operator error]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 090, 11-12.; LLOYDS LIST, 1989, 24 AUG.; GUARDIAN, 1989, 5 JUN.; HAZARDOUS CARGO BULLETIN, 1989, AUG.

Location : Ufa; Siberia, RUSSIA

Injured : 706 **Dead** : 462

Abstract

Engineers in charge of an LPG pipeline carrying material from gas fields noticed a sudden drop in pressure at the pumping end of the pipeline. The pipeline was commissioned in 1985 to carry mixed LPG (propane, butane, pentane, methane and ethane) to feed an industrial city. Subsequently, it had been reported that there had been leaking for "several days" and that a heavy smell of gas had been reported a few hours before the explosions and fire. Instead of investigating the trouble, the engineers had responded by increasing the pumping rate in order to maintain the required pressure in the pipeline. The actual leakage point was about 890 miles down stream between two towns, where the pipeline was installed about 1/2 mile away to the side of a railway. The smell of escaping gas was reported from valley settlements in the area and it is also stated that the escaping liquefied gas formed two large pockets in low lying areas along the railway line. The gas cloud is reported to have drifted for a distance of 5 miles. Some hours later, two passenger trains, travelling in opposite directions, approached the area. Their turbulence mixed up LPG mist and vapour with the overlying air to form a flammable cloud section. One or the other train sparked off the cloud (electric overhead catenary wires for the locomotives) as an initial explosion.

Two explosions took place in quick succession followed by a wall of fire that was about 1 mile wide which raced down the railroad tracks in both directions. A considerable part of each train was derailed. Trees were flattened within a radius of 2 and a 1/2 miles from the explosion centre and windows were broken up to 8 miles away. Fatality.

[fire - consequence, operation inadequate, operator error, rail transportation, vapour cloud explosion, derailment - consequence, transportation, passenger train, injury]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Reaction products for an agrochemical product were charged to a 2,000 litre glass lined batch reactor one Friday evening. According to the process instructions, the reaction should have been started only after the addition of caustic soda on Monday morning. The reactants were left in the vessel at ambient temperature, without agitation or supervision, over the weekend. The thermal behaviour of the reaction mixture (without caustic soda) had not been investigated.

Contrary to previous weekends when a similar procedure had been followed, the reactants started to self-heat and a runaway reaction occurred after about 45 hours. Part of the batch was blown out of the reactor.

[batch reaction, storage, product loss, gas / vapour release, safety procedures inadequate, reactors and reaction equipment, uncontrolled reaction, overheating]

Lessons

Laboratory analysis revealed a high reaction and decomposition energy (potential adiabatic temperature rise 700 degrees C). Simulations based on this data showed a 'temperature runaway curve' similar to that shown in the incident, for a starting temperature of 28 degrees C - roughly in line with the ambient temperature over that weekend. Ambient temperatures for previous batches left in this way without overheating had been somewhat lower.

The following recommendations were made:

1. Process instructions must indicate at which steps the process may be interrupted without risk
 2. Thermal behaviour of the reaction mixture must be measured and hazard analysis carried out.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Reaction products for an agrochemical product were charged to a 2,000 litre glass lined batch reactor one Friday evening. According to the process instructions, the reaction should have been started only after the addition of caustic soda on Monday morning. The reactants were left in the vessel at ambient temperature, without agitation or supervision, over the weekend. The thermal behaviour of the reaction mixture (without caustic soda) had not been investigated.

Contrary to previous weekends when a similar procedure had been followed, the reactants started to self-heat and a runaway reaction occurred after about 45 hours. Part of the batch was blown out of the reactor.

[batch reaction, storage, product loss, gas / vapour release, safety procedures inadequate, uncontrolled reaction, overheating, batch reactor]

Lessons

Laboratory analysis revealed a high reaction and decomposition energy (potential adiabatic temperature rise 700 degrees C). Simulations based on this data showed a 'temperature runaway curve' similar to that shown in the incident, for a starting temperature of 28 degrees C - roughly in line with the ambient temperature over that weekend. Ambient temperatures for previous batches left in this way without overheating had been somewhat lower.

It was recommended that:

1. Process instructions must indicate at which steps the process may be interrupted without risk.
 2. Thermal behaviour of the reaction mixture must be measured and hazard analysis carried out.
-

4566 03 May 1989

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, JUL.

Location : Bayonne; New Jersey, USA

Injured : 0 **Dead** : 0

Abstract

A river transportation incident. During the loading of a barge with fuel oil, an overflow occurred of 14000 gallons into a harbour. Operator asleep. Spill.
[operator error]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 106, 17-18.

Location : , UK

Injured : 0 Dead : 0

Abstract

A cylinder was one of a batch of 27 sent for recharging having a capacity of 1240 litres/132 atmospheres and marked only to be charged to 1800 psi. The compressor being used for the operation was only calibrated for larger capacity cylinders, the pressure relief device being set in excess of 3000 psi. It was the contractor's usual practice to watch the compressor gauges when recharging smaller capacity cylinders and turn off the compressor when the appropriate pressure had been reached.

During the operation of recharging when the cylinders were being charged in batches of four, the person watching the compressor went away to carry out another task leaving the compressor still running and unattended. Whilst he was absent the explosion occurred damaging the compressor and sending four fragments of the cylinder flying across the workshop and through the roof. Despite a request to preserve the contents of the remaining three cylinders these were discharged to atmosphere as were those previously charged. The compressor, cylinder fragments and other cylinders were taken by HSE for examination as part of their investigation.

The following conclusions were made:

1. The cause of the explosion at the contractor's depot was considered to be a combination of the compressor being left unattended resulting in some over-pressurisation together with the poor state of the cylinder internally.
2. There did not exist within the company any policy regarding the life expectancy of BA cylinders.

The following recommendations were made:

1. The provision of new cylinders.
2. That the arrangements for future volumetric (hydraulic) testing be carried out strictly in accordance with British Standard 5430: Part 1: 1977 particular attention being given to:

- Full internal and external examination of cylinders.
- Removal of all loose internal matter and remedial treatment/cleaning if necessary.
- Suitable drying of cylinders after hydraulic test.
- Further internal examination to ensure all moisture has been removed.
- Checking and cleaning of neck threads to remove particles of jointing or other foreign matter.
- Full examination and maintenance of valves before being refitted.
- Valves to be secured to their optimum torque setting.

3. That the company adopt a policy of discontinuing the use of breathing apparatus cylinders after 25 years' service unless previously condemned due to effect. That such a policy be continually monitored and reviewed in the light of national guidance/standards and have cognizance of Local Authority Fire Brigade policies.

[contractor error]

Lessons

1. Familiarity with procedures and having had no associated incidents does not mean everything is satisfactory.
2. Regular audit of all procedures would likely to highlight shortcomings. Unless the above are recognized, there could be many accidents of a similar nature waiting to happen.

4516 25 March 1989

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, JUN.

Location : Monrovia, LIBERIA

Injured : 4 **Dead** : 3

Abstract

Welding work on deck piping of a marine tanker just after discharge of gasoline. Illegal hotwork. Fatality.
[operator error, hot surface]

Lessons

[None Reported]

4483 20 March 1989

Source : ENVIRONMENTAL EMERGENCIES: A REVIEW OF EMERGENCIES AND DISASTERS INVOLVING HAZARDOUS SUBSTANCES OVER THE PAST TEN YEARS, UNITED NATIONS CENTRE FOR URGENT ENVIRONMENTAL ASSISTANCE, UNITED NATIONS ENVIRONMENT PROGRAMME, 1993

Location : Jonova, LITHUANIA

Injured : 55 **Dead :** 6

Abstract

An isothermal storage tank holding liquid ammonia exploded releasing 7,000 tonnes into the environment. The explosion thrust the holding tank forwards, destroying the protective reinforced concrete housing and gantries supporting pipelines. A natural gas pipeline ruptured and mixed with the ammonia. The mixture caught fire, in turn igniting a store of nitrogen-phosphorus-potassium fertiliser. As this burned, ammonia, nitrogen and chlorine were emitted.

[fire - consequence, evacuation, fatality, operator error]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A caulking mechanic died when the scaffold on which he was working failed and caused him to fall 60 feet to the ground. The victim and a co-worker were caulking the exterior skin plate joints and windows of a new seven-story building. Most of the work on the lower levels of the building had previously been completed using a personnel hoist. The upper floors of the building could not be reached with this device, so the crew brought a suspension scaffold to the site on the day of the incident.

On arrival, the crew found that workers from a window-washing firm had already rigged a two-point suspension scaffold on the building. An arrangement was made for one crew of a worker from each company to work from the caulker's manlift, while a second crew worked from the window-washer's two point suspension scaffold. The victim and one worker from the window-washing firm then ascended the building using the two-point suspension scaffold and began work at the sixth floor.

Although the victim and his co-worker had brought safety belts and lifelines to the site, they had been left in the company truck. None of the four workers were using fall protection equipment.

When work was completed at the sixth floor, the men began their descent. Suddenly, the victim's end of the scaffold dropped to the vertical position, causing him to fall. The second man on the scaffold managed to cling to the scaffold and a nearby window ledge until he could be rescued.

Inspection of the scaffold hoist revealed a defect in a centrifugal safety brake. This defect and the victim's possible failure to release the parking brake before beginning his descent caused one end of the scaffold to drop.

[scaffolding, maintenance, mechanical equipment failure, safety procedures inadequate, fatality]

Lessons

[None Reported]

1211912 January 1989

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

Whilst working on the demolition of a cooling tower, a contractor was fatally injured when he fell from a working platform.

An investigation into the incident concluded that the contractor had fallen while attempting to cross a gap between two working platforms. There were no witnesses, however circumstantial evidence indicated that the contractor had fallen when a poor quality scaffold board bridging the gap gave way under his weight.

[fall, scaffolding, fatality, safety procedures inadequate]

Lessons

[None Reported]

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 2

Abstract

A minor leak had been detected in a flange on the piping of the ammonia synthesis loop. On-stream repair by a specialised external contractor had been attempted (fabrication of a special bracket for the flange to hold filling material). During the repair some stud bolts broke. The escaping mixture exploded, killing 2 workers. Piping of the plant was damaged and a prolonged shut-down was necessary. Investigations showed that the flange stud bolts had been replaced with others made of a material not equivalent to the originally specified one, and that the maintenance company had not taken into account the overpressure that was to be created by the injection of the filling material. Fatality.

[explosion, damage to equipment, operator error]

Lessons

1. Compilation of written maintenance procedures with emphasis on safety issues.
 2. Establishment of the sequence of operations to be followed during repair of such valves.
-

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 5 **Dead :** 2

Abstract

Liquid ammonia was imported from the factory ring main to the ammonia injector installation of the urea unit through a surge drum, where it is mixed with recycled ammonia and where the pressure is boosted from about 21 bar (300 psi) to about 239 bar (3400 psi) by a conventional horizontal action-3 throw pump. The crankcase of this pump was punctured by fragments of the failed pump-ram crankshaft. The two operators investigating previously reported noises from the pump, were engulfed with ammonia and immediately surrounded by fumes.

Once the pump crankcase was broken, nothing could be done to prevent the release of the content of the surge drum (10 tonnes released in the first three minutes). The supply of ammonia from the ring main could only be stopped by switching off locally the supply pump. Thus, ammonia release continued.

Ammonia fumes quickly began to enter the plant control room and the operators hardly had the time to sound the alarms and start shutting down the plant before they had to leave the building using 10-minute escape breathing sets. The on-site emergency plan was activated within minutes after the alarm had sounded, a roll call quickly established that only two men were missing. Two gas-tight suits were used to search and rescue rather than to isolate the ammonia ring supply. The isolation of the main ring was achieved 40 minutes after the start of the release; in this lapse of time 28 tonnes of ammonia (in addition to the 10 tonnes initially released) escaped into the atmosphere.

The off-site emergency plan was activated within 5 minutes from the start of the release. Local radio warnings were given, but this was too late for some local schools, some mothers and children were affected while making their way home (the accident occurred at about 15.30h).

During the search and rescue operation, the fire authorities did not use gas-tight suits and fumes entered the gaps around the face piece and caused injuries to 5 men.

From the effects described and from post-accident modelling, it was likely that the ammonia concentrations were of the order of 150 ppm for 10 minutes at 3 km, dropping to 50 ppm for 15 minutes at about 7 km. A substantial number of people complained about the fume (up to 7 km away), but nobody was seriously affected. Fatality.

[drums, pump failure, safety procedures inadequate, design inadequate, processing, injury]

Lessons

1. Existing similar pumps will be thoroughly examined and fitted with crankshaft deflection devices.
2. Critical plant machinery will be identified and subjected to a regime of inspections similar to that applied to pressure vessels.
3. Automatic remotely operated shut-off valves will be fitted to liquid ammonia supply systems so that a hazardous piece of the plant can be isolated quickly.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Cracked Fluid Catalytic Cracker Unit (FCCU) reactor vapour line at a refining company. During start-up of the FCCU, and shortly after the introduction of feed, vapour was noticed to be coming from the insulation around the reactor vapour pipeline and support hanger. There was product loss and damage to equipment. Failure of the line was due to thermal fatigue. A contributing factor was inadequate insulation that allowed plates to remain cool and not expand with the line, acting as a restraint. Insufficient maintenance of insulation around the line in recent years was the cause of this incident, in addition to inadequate design of support section.

[maintenance inadequate, design inadequate, fluid cracker]

Lessons

Particular care is needed in regular inspection and necessary repair of plant which is the subject of significant temperature cycles with possibilities of thermal fatigue.

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Due to a short circuit in one of the switch cupboards (25 kV), a fire occurred involving 3/4 of the plant's electric station and 10 switch cupboards. This resulted in the automatic shutdown of the chlorine production plant (except of the chlorine destruction unit) and the hexachloro benzene (HCB) production due to lack of adequate cooling capacity. The chlorine production facility remained 10 days off stream while the HCB production was resumed with imported chlorine. Gradual carbon formation in the mineral oil is suspected to be the cause of the short circuit.

[electrical, power supply failure, design inadequate]

Lessons

1. Installation of an inert gas-filled switch-cupboard instead of the oil-filled type.
 2. Installation of the new switch cupboard in separate compartments using a fire-resistant partition.
-

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A storage tank for aqueous ammonia solutions was up for maintenance (replacement of the bottom part). After mechanical completion of the replacement work, a trial had been undertaken to fill the tank up, but overpressure was registered and the flange connecting the feeding line to the tank leaked. The problems were reported to the maintenance department, the flange connection was repaired and the pressure relief line checked, the trial to fill the tank was not reported to the shift supervisor. The next day a safe work-permit was issued to the mechanics to disconnect the piping associated with this tank for further repair. The repair work proceeded and during the grinding of a disconnected pipe, a mechanic noticed a whistling sound and hid, together with the other mechanics, behind a concrete tankfarm wall. Soon afterwards the tank exploded. The top of the tank was blown over an adjacent building and the office buildings, and bumped into another office building (approximately 60 m away), which was empty. The explosion is believed to be caused by the ignition of ammonia vapour caused by the repair works. Also the pressure relief line failed to perform as expected.

[storage tanks, overpressurisation, maintenance inadequate, damage to equipment, design inadequate]

Lessons

1. Improvement of procedures.
 2. Improvement of communication.
 3. Improvement of training of personnel.
 4. Re-design of vapour relief lines.
-

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

During the manufacture of lubricating oil, there was a build-up of asphalt and other residual oils in the circulating propane system. This material was drained each shift from an accumulator vessel into a drain vessel, which is often flushed out with hot gas oil or flushing oil. The accumulator had a capacity of approximately 24 ton of propane (50 degrees C/21 bar). During the shift preceding the accident, the drain line from the drain vessel was found to be plugged; after an unsuccessful attempt to remedy this, the drain valve was closed. Draining of the asphalt and other residual oils from the circulating system into the drain vessel was started. About two hours later, a large quantity of propane escaped from the drain vessel and drifted 20-30 m towards the centre of the process plant. The operator noticed a gas cloud and at the same time, the propane low-level alarm sounded in the control room. The shift controller closed the valve between the propane recirculation system and the drain vessel manually. The on-site emergency services were called, but on their arrival the gas cloud had safely dispersed. The propane release was attributed to the plugging of the drain valve by a solid plug of asphalt and/or ice, preventing it from fully closing after draining. This plug became dislodged from the recirculation system to the drain vessel due to the propane pressure during draining. No double valve had been provided on the drain line and operating instructions did not adequately deal with the procedures to be followed in case of a blockage.

[gas / vapour release, design inadequate, refining, valve failure]

Lessons

1. An additional spring load valve will be installed in the drain line so as to close automatically when a blockage clears.
 2. Operating instructions have been updated to include a requirement that the drain vessel and its drain line should be flushed after each draining operation with gas-oil so as to prevent accumulation of solid asphalt.
 3. The drain system will be redesigned so that asphalt is drained from the vessel via a closed system, thereby removing the potential risk of a release to the atmosphere (inherent safe design).
-

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 2 **Dead :** 0

Abstract

Laboratory trials had shown that distillation of a crude 2-nitroimidazole compound at 100 degrees C under vacuum yields a pure product. This operation was repeated at pilot-plant scale in a 450 l glass-lined reactor. As soon as the substance was dissolved and the reactor agitator was turned on, a yellow fume began to emerge from the closed manway. The pilot plant operator left the place and within seconds 2 successive explosions (blast 2.5 kg TNT equivalent approximately) were heard. The process plant was severely damaged, windows broke in a radius of 30 m, while windows of houses in the town 2 km away shook, 2 operators were slightly injured. Though danger of an explosion for this substance was suspected, no relevant data had yet been experimentally obtained. This was planned before the substance was to be used at production scale. The local police evacuated 2 nearby (100 m away) factories (300 people evacuated). The fire was already under control when the local fire brigade arrived on the scene. The smoke from the fire and the explosion drifted slowly (calm day) towards a nearby town, causing public concern. The manufacturer alleviated the public's fears by stating on national radio and TV that the smoke was not toxic.

[reactors and reaction equipment, evacuation, fire - consequence, damage to equipment, laboratory work, runaway reaction, safety procedures inadequate, injury]

Lessons

123881989

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A contractor was killed after falling off a stationary vehicle and was trapped under steelwork beams that were dislogged from the trailer at the same time. The incident occurred when the contractor stood on adjacent beams, an unsafe position, during a lift.
[safety procedures inadequate, fall, fatality, road vehicle]

Lessons

[None Reported]

123841989

Source : ICHEME

Location : ,

Injured : 0 Dead : 2

Abstract

Two workers were killed during work to dismantle scaffolding.

The incident occurred after maintenance had been carried out on a 50 metre high distillation column when the workers were dismantling the scaffolding. For this work a construction lift was being used. After several days without warning, the platform collapsed with the two workers on it.

An investigation into the cause revealed that the driving shaft in the brake system was broken, leaving the platform without any braking device.

[operational activities, mechanical equipment failure, fall, fatality, safety procedures inadequate, lifting equipment]

Lessons

The report stated the following lesson learned:

The importance of regular inspections, aimed at vulnerable parts.

Source : ICHEME

Location : , IRELAND

Injured : 0 Dead : 0

Abstract

An explosion occurred when effluent system water was injected into a syngas mixture (hydrogen/carbon monoxide/carbon dioxide/nitrogen) to cool the gas. The water injection nozzle was intended to inject water directly into the gas stream. Following the explosion the nozzle was found to be bent at 45 degrees. It was believed that this did not occur during the explosion, but two years previously during routine maintenance, when a crane incident occurred during nozzle re-installation.

Consequently the water stream injected directly onto the inner pipe wall rather than into the gas stream, causing stress corrosion and pipe rupture.

An approximate five metre rupture opened up on a seamless weld downstream of the injection nozzle which is believed to have been due to carbonic acid corrosion.

[cooling, maintenance inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A cement finisher died when he fell from a suspension scaffold and his safety lanyard snapped. The victim and a co-worker were dismantling suspended scaffolding at a 160-foot level inside a concrete silo. Both men were wearing safety belts with nylon rope lanyards secured to independent lifelines.

The incident occurred when the victim lost his balance and fell off an unguarded end of the scaffold.

His co-worker stated that he saw the victim fall and jerk upwards as the lanyard caught him. When

the victim's weight dropped back on the lanyard, it snapped, and he fell to the concrete floor.

Examination of the lanyard after the event showed burn damage at several places, including the point of failure. The employer did not control inspection or distribution of this fall protection equipment.

The equipment was kept in a common supply bin where the workers could readily obtain it when needed and return it when work was completed. The lanyard

had probably been damaged earlier during cutting and welding operations.

[scaffolding, personal protective equipment, fall, safety procedures inadequate, material of construction failure, fatality, maintenance]

Lessons

[None Reported]

Source : ICHEME

Location : , GERMANY

Injured : 3 Dead : 0

Abstract

Three men inside a reactor vessel experienced breathing difficulties. They had inhaled vapour containing 1,1,1-trichloroethane as a result of using a cleaning agent in a poorly ventilated confined space. The three men were taken to hospital for observation and tests. They were discharged on the day following the incident and returned to work fully recovered two days later.

The incident resulted from using a hazardous cleaning solvent in an inadequately ventilated confined space. The solvent contained 1,1,1-trichloroethane a harmful substance which should not be inhaled. In addition to the air flow being inadequate to effectively dilute the solvent vapours, the direction of ventilation was wrong. For this heavier than air vapour the air flow should have been from the top downwards.

[entry into confined space, asphyxiation, cleaning procedure incorrect]

Lessons

1. No cleaning agents containing solvents should be used in restricted spaces - such as tankers, columns, reactors, large pipelines etc. For the weld testing, water should be used instead of solvent based agents. Investigations should take place as to whether a harmless test process could be used instead of the dye disclosure method.
2. When using a solvent based cleaner, adequate air supply and ventilation should be ensured. If the fumes are heavier than air, they should be extracted from below.
3. If the ventilation is insufficient, independent breathing apparatus must be used.
4. If possible, work should not be carried out on a vessel at the same time as work in the vessel. If this is unavoidable, the persons working inside should be informed of the nature and scope of work being carried out on the outside. We should also check that safety measures governing work in tanks are adequate. A special co-ordinator is required for this.
5. On medical recommendation, various medications should be kept on site, such as Folon A 200 mg injection ampules and Auxilosan measured dose aerosols.
6. All jobs should be carefully planned from beginning to end. Deviations from the plan should require formal authorisation at a high level. Existing work permits should be withdrawn and new permits issued to cover the change in scope. There is a tendency to take less care towards the end of a job as the pressure to recommission plant and equipment increases.
7. The site policy on the use of solvents (and other hazardous chemicals) should be made absolutely clear to everyone who could be affected by their use. Inherent methods of enforcement of the policy should be devised. e.g. if particular solvent based cleaners are not allowed on site the purchasing system should prevent orders for them from being processed.

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

A rail transport incident. Whilst disconnecting the loading arm after completion of a railcar filling operation about 250 kg of propylene were released to atmosphere due to a valve operating sequence error. Fortunately the release was not ignited and an operator sustained only minor injuries.

The causes which contributed to the release of propylene were listed as follows:

1. Failure of the manual block valve/flare vent system to depressurise the loading arm filling line.
2. Failure of operators to follow standing instructions i.e. failure to use loading arm check valves to confirm depressurisation.
3. Block/vent valves operated a second time with flange still unbolted.
4. Time pressure. Faced with a very high loading frequency two men employed for an operation normally done routinely by one man. However this introduced communication/co-ordination problems and reduced the time allowed to vent the filling line.
5. The second operating error (i.e. operating the block valve with the flange still unbolted) occurred when the operator was perhaps still unsettled by the initial release of gas).

[gas / vapour release, valve failure, operator error, injury]

Lessons

1. On-the-job training should stress the importance of following the standing procedures.
 2. The incident also illustrates the importance of communications/planning at all levels in ensuring safe operation.
 3. When evaluating process changes the effect of changing the elapsed time between sequential operations needs to be considered; such deviations also need to be included in HAZOP studies of sequential/batch operations.
-

Source : ICHEME**Location :** , UK**Injured :** 0 **Dead :** 0**Abstract**

At approximately 14.00 hours on 5th September 1988, an air supply hose on the discharge side of a portable breathing air receiver became detached whilst in use.

One individual was carrying out an internal inspection of the Solvent Recovery Column at the time. He was therefore immediately deprived of an air supply. Very prompt action by the compressor attendant, with the assistance of a fireman enabled restoration of the air supply within a few seconds. An emergency call was made to the Fire Station for additional backup, but the individual concerned was able to make his own way out of the column, and suffered no physical effects.

On examination the crimping rings attaching the pressure hose to the bayonet connection were found to be loose and showed no signs of ever being compressed.

Following the incident, all work involving mobile breathing air systems was stopped. It turned out that all hoses arrived in vacuum sealed packs which were only opened at the work-site. No inspection or testing was therefore performed and no documentation accompanied the hose to indicate what Quality Assurance procedures had been followed.

[inspection, entry into confined space, near miss, breathing apparatus, air line, human causes, design fault]

Lessons

All hoses were examined and certified on site immediately.

Some hose lengths were found to have only one crimp-ring applied, rather than the usual two. Initially it was accepted that a second ring should be applied.

However, the contractor subsequently discussed this matter with the supplier who advised against this course of action. Clamping is normally carried out whilst the hose is being heat-shrunk onto the fitting. Any attempt to add a second clamp 'cold' might affect the integrity of the original bond.

All such hoses were therefore withdrawn from service, and have been replaced by others, which incorporate an improved coupling design.

For vessel entry the statutory requirement is for an outside observer who is similarly clothed (and therefore has breathing apparatus (BA) at the ready) whose primary responsibility is to summon assistance in the event of a dangerous situation arising, and to then attempt a rescue. The shutdown arrangements require each party to make its own arrangements for observers. This could therefore involve personnel who had only limited BA training. This situation was revised.

Source : ICHEME

Location : , UK

Injured : - Dead : -

Abstract

This incident concerns the contamination of the public water supply from a water treatment works. This was caused by a supply of aluminium sulphate solution being discharged into the wrong tank.

A relief driver arrived to discharge his road tanker of aluminium sulphate solution at the water treatment works (which was, at the time unmanned). The regular driver had given him a key to obtain access, and verbal instructions as to where to discharge the solution. Once inside the works, the relief driver found what he thought was the correct storage tank to accept the load, and opened the cover using the same key. He then discharged the load and left (without any contact with water works staff).

The aluminium sulphate had in fact been discharge into the 'contact tank' (which fed treated water directly into the reservoir) instead of into the aluminium sulphate storage tank. Thus relatively high levels of aluminium were present in water supplies to a large number of consumers.

Complaints from consumers started later that day, however diagnosis of the real problem was delayed and confused by coincidental problems with lime dosing pumps, also causing low pH levels in the treated water. It was not until two days later that the true reason for the incident was discovered.

The contaminated water caused widespread alarm and discomfort amongst consumers (although probably little long-term health effects). Flushing of the contaminated water into rivers (to clear the distribution system) led to substantial fish kills.

[material transfer, unloading, pollution, poisoning, ecological damage, incorrect chemical concentration, chemicals added incorrectly, driver error, safety procedures inadequate, storage tanks, contamination]

Lessons

A detailed enquiry and report was produced: this recommended a number of improvements:

1. More rigorous control of key security.
 2. More rigorous systems for receiving goods.
 3. Improved monitoring instruments for final treated water quality.
 4. Better labelling of installations.
 5. Improved emergency procedures, both in terms of response to the incident and to communications with the public.
 6. Adoption of the Hazard Study technique.
-

Source : THE PUBLIC INQUIRY INTO THE PIPER ALPHA DISASTER, CHAIRMAN: THE HON LORD CULLEN, DEPARTMENT OF ENERGY, HMSO, 1990, CM1310, ISBN 010113102;TIMES AND MANY OTHERS

Location : Piper Alpha; North Sea, UK

Injured : 0 **Dead :** 167

Abstract

An explosion and subsequent fire occurred at 22:00 on 6 July 1988 on a rig in the North Sea. 167 oil workers were killed, the platform totally destroyed and hydrocarbon production temporarily dropped by 11%. The platform produced both oil and gas. It was also the hub of a four-rig network passing oil and gas to the Orkneys. At the time of the disaster the rig was undergoing large-scale maintenance.

One process on the rig involved removing condensate from the gas and pumping it into the main oil lines. The condensate was injected into the oil line by one of two pumps, labelled A and B.

On 4 July it was decided to bring forward the maintenance of pump A by one month because it had been running noisily. Contractors were asked to carry out a recertification on the relief valve of pump A at the same time.

Pump A was isolated during the morning of 6 July. The safety relief valve was removed and the relief line blanked off by a flange. Separate permits-to-work (PTW) were issued for each job. The flange should have been made 'leak-tight' with a spanner but at this time it was left 'finger-tight' only. The plan was to refit the relief valve by 18:00.

The relief valve was recertified on 6 July, but not replaced on the relief line as the crane was unavailable. After some work on pump A had been completed, the maintenance manager had decided not to continue with the planned maintenance but had not yet informed staff.

On shift hand-over at 18:00, the night shift were told that pump A was operational. However they were not informed of the work which had been carried out on the relief valve. At 21:40 pump B tripped and attempts to restart the pump failed. Operations staff decided to reinstate pump A to maintain production. The isolation on pump A was removed and an electrician called in to restore power. The feed valves on pump A were then opened.

A low level gas alarm was recorded at 21:56 and this was followed by a high level alarm at 22:00. An explosion equivalent to 50 kg of condensate occurred.

This explosion killed a number of people and destroyed the fire-fighting system. A mayday was issued but the ensuing fire rapidly engulfed the control room and severely damaged the rig's communications systems.

Emergency isolation valves on the rig failed to close and the fire escalated to a major jet fire. Flame impingement, due to the continuing leakage of gas flows from the other rigs, caused the gas risers to fail. This led to a series of massive explosions. The platform controller tried to enact the practised emergency plan, but failed due to the conditions. Fatality.

[offshore, fire - consequence, permit to work system inadequate, blind/spade/slip plate, shift change]

Lessons

The root causes of the incident included:

Inadequate permit-to-work system. The PTW for the relief valve should have been suspended, however, evidence suggests that the maintenance staff were unaware that the valve had not been refitted and it was unlikely that the operations staff signed off the PTW as required.

1. Poor organisation between production and maintenance.
 2. Inadequate shift change over procedures.
 3. Inadequate allocation of time to complete the job.
 4. Failure to manage change as rig processes were extended.
 5. Unclear assignment of responsibilities.
 6. Poor emergency planning, no plans for evacuation by sea or for loss of services. The majority of the fatalities were caused by smoke inhalation and occurred in the galley or accommodation areas.
 7. Inadequate display and access to information.
 8. Inadequate emergency control centre.
 9. Lack of isolation from gas lines of other rigs. The adjacent rigs continued to feed gas and oil to the rig for over an hour.
 10. Large volume of gas stored in risers.
-

4220 06 July 1988

Source : EVENING COURIER, 1989, 24 JAN.

Location : Halifax, UK

Injured : 1 Dead : 0

Abstract

A solid mass of dye developed in a caustic chemical reactor and attempts were made to acidify it. Also attempts were made to disperse it without success. A man entered the reactor and acid got into his boots causing burns. Company fined £800 (1988) for failing to ensure safety and £200 (1988) for failing to report the accident.

[reactors and reaction equipment, safety procedures inadequate, maintenance]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 122, 9-10.

Location : ,

Injured : 0 Dead : 5

Abstract

The accident occurred in a plant making dyes and a chromate dip for electroplated products. These products were treated in a series of open-topped tanks located in a sub-basement, known as the zinc-plating room, which contained two parallel rows of tanks separated by a grated walkway. A concrete drainage pit lay beneath the walkway. Ventilation in the zinc-plating room was provided by two ceiling exhaust fans, five windows and the door to the room were closed at the time of the accident.

The last tank in the series, where the accident occurred, was used for drying parts after they had been electroplated. The tank measured 1.5 x 1.2 x 1.5 metres. The parts were suspended above the tank, and excess zinc cyanide solution dripped into the tank. Waste zinc cyanide was pumped from the tank once each year.

On the day before the accident, an industrial cleaning and hauling company pumped the waste from the tank, leaving a layer of zinc cyanide sludge in the bottom. On the day of the accident the night shift leader began preparations to clean the remaining sludge by spraying 1 or 2 gallons of hydrochloric acid into the drying tank.

After investigation it was concluded that the night shift leader unknowingly created hydrogen cyanide, a highly toxic compound, by combining sulphuric acid and zinc cyanide, two commonly used industrial chemicals. Hydrogen cyanide acts to block absorption of oxygen by the lungs and can cause death.

After adding the sulphuric acid, the night shift leader, who worked alone and wore no respirator, climbed a ladder and descended into the tank. He did not test or ventilate the tank before entering. After several minutes, co-workers saw him struggling to climb out of the tank.

Four other workers attempted to help and were quickly overcome. Two were forced back by the vapours. The other two collapsed, one inside the tank and the other with his head hanging over the edge. Fatality.

[accidental mixing, testing inadequate, entry into confined space, safety procedures inadequate]

Lessons

Chemical safety.

Ensure that good chemical safety practices are followed in the workplace:

1. Chemicals must be clearly labelled. Labels must be legible and in English. Warnings to be provided in other languages, as necessary.
2. More emphasis must be placed on dangers that can result from combining chemicals. Workers to be trained to recognise and anticipate hazardous chemical reactions.
3. Materials safety data sheets must provide necessary warnings as well as other important information on chemical hazards.

Ensure that confined spaces are clearly identified and that workers can perform tasks safely within these areas.

1. Workers must be trained to recognise confined spaces, and management must take appropriate precautions to ensure that work is performed safely.
2. A confined-space work plan must include a method or plan for rescue. The safest methods for confined-space rescue do not require that rescuers enter these hazardous areas. Body harnesses, safety lines, and reliance on the buddy system can prevent unnecessary risks.
3. Entry permit systems are a must, and issue of these is likely to be subject to environmental analysis for toxic or flammable gases, and oxygen content.

Ensure that all personnel know what to do in the event of an emergency.

1. Notify authorities immediately when an emergency occurs. Workers or supervisors who are likely to witness or discover an injured or collapsed co-worker should be trained to initiate an emergency response sequence.
2. Ensure that workers (first responders at the operations level) are training to take appropriate actions and precautions. Workers must never enter a confined space for the purpose of rescue without suitable breathing apparatus.
3. Ensure that all emergency response personnel are properly informed and trained. In this instance, emergency response crews were initially unaware that hydrogen cyanide was involved.

Source : OIL AND GAS JOURNAL, 1989, 23 SEP.

Location : , NORTH SEA

Injured : 0 Dead : 0

Abstract

A marine transportation incident. A marine freighter was in collision with an offshore oil rig. The duty officer went to bed after setting the autopilot without leaving a look out.

[operator error]

Lessons

[None Reported]

Source : ICHEME

Location : , PORTUGAL

Injured : 1 Dead : 1

Abstract

A road transportation incident. A vapour cloud explosion and fire occurred when a road tanker was discharging toluene to a storage tank.

The storage tank was located in a building which was also used for the storage of plastic rolls and printing inks.

The explosion occurred about halfway through the delivery of 3,000 litres of toluene causing extensive damage to the building.

The ignition source was not identified, but could have been:

1. Discharge of static electricity.
2. Spark caused by contact of two metal objects inside the building.
3. Operator smoking inside the building.
4. Operator lighting a match or switching on some other means of illumination in order to see what he was doing.

[material transfer, lightning, mechanical spark, cigarette, damage to equipment, fatality]

Lessons

The following conclusions were made:

Due to the lack of proper facilities for the receipt and storage of highly flammable liquids, it was difficult to pinpoint the most probable cause of the accident.

Possible reasons for the presence of a flammable vapour/air mixture inside the building were:

1. The free venting of toluene vapour from the tank into the surrounding air inside the building, which was almost totally devoid of natural ventilation.
 2. Lack of direct supervision of the unloading operation from within the building, coupled with the tank drain cock being left open, leading to a pool of toluene collecting inside the building.
 3. The customer's delivery hose becoming detached from the top of the tank, also resulting in a spillage of toluene inside the building.
-

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1988, SEP. FIRE PREVENTION 217, 1989, MAR.

Location : Savansk, USSR

Injured : - **Dead :** 0

Abstract

Glowing cigarette ash in a waste bin was the source of ignition for this fire which destroyed a warehouse and caused injury to several workers. The warehouse was used to store saltpetre, wax and other flammable materials. After ignition of nearby combustibles the contents of the warehouse ignited explosively, shattering windows of adjoining workshops and igniting nearby woodpiles.

[fire - consequence, warehousing]

Lessons

[None Reported]

Source : HOUSTON CHRONICLE, 1989, 24, OCT.; LOSS PREVENTION BULLETIN, 099, 13

Location : Port Arthur; Texas, USA

Injured : 0 Dead : 0

Abstract

A catastrophic failure of a 6-inch propane line and ignition of the resulting vapour cloud at a refinery tank pump station led to the subsequent failure of numerous other pipelines in the 50-foot-wide pipe trench. The intense fire quickly involved four 18,000 barrel, internal floating roof blending tanks containing raffinate, debutanised aromatic concentrate, and slop. Three of the tanks were lined up to piping in the trench and there was difficulty isolating the tanks and pipelines. Two empty spheroids were heavily exposed. The fire spread throughout the trench, and was extinguished 20 hours later.

[pipeline failure, fire - consequence, isolation inadequate, refining, floating roof tank, metal fatigue, vapour cloud explosion]

Lessons

[None Reported]

4174 25 May 1988

Source : HAZARDOUS CARGO BULLETIN, 1988, JUL/AUG.

Location : Sarnia; Ontario, CANADA

Injured : 0 **Dead** : 0

Abstract

Worker error released 12,000 kgs of acrylonitrile into a river. Four water purification plants were forced to shutdown temporarily.
[spill, operator error, processing, plant shutdown]

Lessons

[None Reported]

Source : THE PEPCON DISASTER A REPORT BY THE UNITED STEELWORKERS OF AMERICA, LOSS PREVENTION BULLETIN, 093, 1-3; BUSINESS INSURANCE, 1988, 30 MAY.

Location : Henderson; Nevada, USA

Injured : 350 **Dead :** 2

Abstract

An explosion occurred in an ammonium perchlorate plant. On the day of the incident several workers noticed flames coming from a small batched drier. Operators used fire hoses to fight the fire. Several polythene drums of ammonium perchlorate were on fire as well as drums of floor sweepings. The walls of the buildings, fibre glass reinforced plastic, were also seen to be on fire. The fire hoses then lost water pressure at which point the building was seen to be full of smoke. The first explosion occurred shortly after the operators had left the building. A fire ball jumped to a larger drier building about 6m away starting another fire and igniting further drums of ammonium perchlorate. The operators of the plant and those in an adjacent factory started evacuating the site. Shortly after there was a massive explosion which demolished the administration building. This explosion also ruptured a 0.41 m. natural gas pipeline and was caused by the detonation of ammonium perchlorate in 2270 kg tote bins. A special area of tote bins detonated and caused the major damage. The shock wave demolished the adjacent marshmallow factory. Property damage occurred up to 19 km away. The most probable cause was the contamination of the insulation of the batch drier at the loading point by ammonium perchlorate.

[fatality, fire/explosion, management system inadequate, maintenance inadequate, heating]

Lessons

A number of contributory factors were also identified:

1. Excessive perchlorate.
 2. The use of combustible material in the plant.
 3. The lack of fire suppression systems in the plant.
 4. Faulty maintenance and housekeeping.
 5. Inadequate training.
 6. Deficiencies in plant layout and design.
 7. Lack of effective emergency response planning.
 8. The lack of comprehensive safety analysis.
 9. Failure to respond to past fires and work complaints.
 10. Lack of enforcement by government agencies.
-

Source : ICHEME**Location :** , HOLLAND**Injured :** 0 **Dead :** 0

Abstract

Two incidents were recorded at a storage depot whereby product tanks A and B overflowed during filling operations.

The first incident involved the loss of 12m³ of diesel oil. The second incident involved the overflow of approximately 480m³ of unleaded gasoline.

Although product overflows were contained and total losses to the company were estimated to be £28,500 (1988) the consequences of such an incident could have been much greater had there been a fire, or had serious ground contamination occurred.

The first overflow was the result of an operator failing to check out an alarm condition. The second occurred after a shift change and no alarm sounded despite the tank being overfilled.

During subsequent investigation it was found that the control room operators were experiencing many difficulties with accommodating the new technology associated with recently installed projects. Particularly, difficulties were occurring on the new computer system, difficulties which were exacerbated by the limited training received.

Subsequent checks also revealed that the level indication on Tank A was reading low by some 600mm.

Tank B was found to have an inoperative high level alarm due to a blown fuse. Operators were aware of the blown fuse conditions, (they had indication) but they were not aware of the implications.

[operator error]

Lessons

Factors such as poor reliability on older equipment, teething problems on new equipment and a lack of proper training on the new system were creating high levels of stress.

The company's review team recommendations included:

1. All tank high level alarms must be made "fail-safe".
 2. Tank high level alarms should be replaced by more robust and weather-resistant equipment.
 3. Research must be carried out to improve tank metering equipment.
 4. Preventative maintenance should be carried out on the tank level alarms.
 5. The control-room layout and equipment installation must be revised and improved.
-

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

The manhole of a polymerisation reactor in operation was opened by mistake for cleaning. The plant was evacuated, the reactor was depressurised and its content transferred to another vessel. Vinyl chloride concentrations in the nearby residential area were measured by the company (values measured up to 1.9 mg/m³).

[reactors and reaction equipment, evacuation, spill]

Lessons

After this accident, a procedure requiring a signature for opening the manhole has been adopted (up to this accident clearance to open a reactor was given independently by 2 operators using a magnet labelling system). The control room must be able to withstand explosions so that control room operators can take proper action in the case of such accidents.

Source : ICHEME

Location : , AUSTRALIA

Injured : 1 Dead : 0

Abstract

Whilst carrying out blank swinging on the Solvent Dewaxing Unit (SDU) Flue Gas Compressor a contract fitter was gassed with a mixture of nitrogen, carbon monoxide and solvent fumes.

Fortunately he recovered after receiving oxygen treatment.

Repairs had been completed on a new SDU Compressor and apart from pressure testing and the sound box being replaced it was ready to be deblanked and returned to service. The old and new compressors have no isolating blockvalves and were separated only by blanks.

Blank swinging began under the guidance of an operator. It appears that there was a slightly positive pressure in the system although there had been an attempt to pull a vacuum on the system using the high pressure flue gas compressor (which basically took suction from the system and blew to atmosphere).

At the same time, instrument fitters were working on the make up/dump controllers, and it appears that the dump controller was on manual control in the open position, ie. it was left floating on the flue gas holder which contained residue cracker flue gas, i.e. carbon monoxide.

The head operator carried out a quick check of the blanks, thought them to be complete and commissioned nitrogen to the system. As there was no pressure build up, a water hose was coupled from the east battery limit and nitrogen line to the system and commissioned. It was then he found the dump valve to the flue gas holder was open and he asked for it to be shut from the control room.

At this time the contract fitter started to remove the last bolt in the already spread flange on the interstage suction line ready to fit the new, longer bolts and the blank spade which had not been left in the line from the last occasion of blank swinging on this compressor.

When leaning forward to do this job his face was close to the spread flange and he would have been breathing the vapours emitting from the flange. He felt dizzy and climbed down to where his trades assistant assisted him toward the control room.

Once in the control room, the fitter was given resuscitation treatment.

[operator error, poisoning, slip plate insertion/removal]

Lessons

The incident would not have happened if more time and care had been taken to ensure the completeness of the system prior to pressuring up.

Recommendations resulting from the near miss investigation were as follows:

1. The importance of site permits to be emphasised to all relevant personnel.
2. Mechanisms for improving the operation of the site permit system to be considered including operator responsibility and a requirement for joint operations/maintenance physical checking.
3. Maintenance and Operations supervisory personnel to have training in site permit and other safety procedures prior to taking on supervisory roles.
4. The importance of supervisors not compromising safe working procedures to shorten plant and equipment down-time must be emphasised.
5. The policy relating to the use of breathing apparatus in nitrogen emission situations to be reviewed; until then Breathing Apparatus (BA) to be used in all such situations.
6. Each Area/Shift to have a qualified First Aider.
7. All Supervisors to be made aware of their responsibility to ensure that all contract personnel for whom they are responsible are trained in all relevant aspects of refinery safety regulations including the use of BA for those required to wear it before commencing work.

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A crystalline finished product was spinning in a batch centrifuge when an explosion occurred. The product had been refrigerated to minus 7 degrees C before it was separated from a methanol/isopropanol mixture. It was subsequently washed with isopropanol pre-cooled to 9 degrees C. The mixture was spinning for about 5 minutes when the explosion occurred in the centrifuge. The lid of the centrifuge was blown off by the force of the explosion. The overpressure shattered nearby glass pipelines and windows inside the process area (up to 20 m away) but nearby plants were not damaged. As no operator was in the vicinity at the time of the explosion, no one was injured. No nitrogen inerting was used and enough time had elapsed to ensure that sufficient air could have been drawn into the machine to create a flammable atmosphere. Sufficient heat could also have been generated by friction to raise the temperature of the solvent medium above its flash point. The ignition of the flammable mixture could also have been caused by metal-to-metal contact between the basket and the bottom outlet chute of the centrifuge, leading to a friction spark, since the Teflon coating on the centrifuge basket was worn away, or by a static discharge (continuity checks failed to eliminate this latter possibility).

[overpressurisation, safety procedures inadequate, batch reaction, separation]

Lessons

[None Reported]

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Due to a defective connection on the suction line of a pump, several tonnes of gaseous hydrocarbons escaped. The cloud ignited at a distance of about 50 m from the leakage source. An attempt to isolate the system failed. The pipeline between the pump and the gas column separator was isolated to avoid fire propagation to other installations, but the jet fire was not extinguished in order to avoid explosive cloud formation. After this accident, the following measures have been established to prevent similar accidents to occur in the future periodic leak test of critical flanges, training of maintenance personnel in assembling these flanges.

[explosion, fire - consequence, training inadequate, operator error, refining]

Lessons

[None Reported]

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 1 **Dead :** 0

Abstract

During charging operations, an operator added a wet powder, using a metal scoop, to the hot drier when an explosion with subsequent flash fire occurred at the charge chute. The automatic sprinkler was automatically activated by the flash fire but was not needed. The powder was damped with toluene. Apparently, an electrostatic discharge ignited the toluene vapours. The operator had superficial burns on hands and face. Nitrogen purging is recommended to be carried out before charging the drier.

[safety procedures inadequate, fire - consequence, charging reactor]

Lessons

[None Reported]

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred during the unloading operations of nitric acid from a road tanker. It seems that, by mistake, the operator connected the wrong tank, i.e. he emptied the nitric acid to a tank containing formic acid. This produced a rapid exothermic reaction that led to the explosion. The explosion was followed by a release of a cloud of yellow/red colour. This cloud presented a strong smell and produced irritation to the eyes and skin. Main pollutants were nitrogen oxides. The fire brigade diluted the liquid acid on the ground with water and created a containment to prevent the acid to spread on the ground. In the meantime the evolution of the cloud was continuously observed from a helicopter.

At the time of the accident the wind direction was towards the sea, where the cloud diluted. The road traffic was prohibited for some hours. The explosion seriously damaged some tanks. Some buildings inside the establishment suffered extensive damage. Broken windows were found up to 300 m away.

[operator error, gas / vapour release, damage to equipment]

Lessons

[None Reported]

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A technician had tested a drier on a number of occasions. He closed the manway, put the drier under vacuum and started rotation. A few minutes later an explosion and flash fire occurred which was self-extinguished. No one was injured. Investigations revealed that after the last testing, the drier manway was not fully fastened. Air must have entered the rotating drier at the manway gasket after sampling. The ignition source could probably be an electrostatic discharge (the Teflon coating on the internal lining of the drier could have built up a charge). No nitrogen inerting was used.

[testing, fire - consequence]

Lessons

1. Nitrogen purging must be carried out before charging/testing the drier.
 2. If the vacuum falls to -0.7 bar, rotation must stop and a nitrogen purge must automatically start. An audible alarm must ring.
 3. The company is presently compiling a computer program for the drying process to ensure that these functions are carried out.
-

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

During maintenance, an attempt was made to free a heater in the chlorine transfer circuit from residual liquid chlorine by introducing pressurised air. Due to an operator error, the chlorine evaporated and entered into the process air system. From this system it leaked at various points of the factory causing also nuisance to the neighbourhood (several complaints recorded by the local police which gave alarm face 2: annoyance, no danger).
[maintenance inadequate]

Lessons

1. Preparation of written maintenance procedures.
 2. Better training of personnel.
-

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

An operator working on a nitrile plant had two fingers of his right hand badly crushed. The incident occurred as the operator was cleaning out the cover ram of a nitrile crumb bailer. The bailer had not been isolated. The bailer went through an automatic cycle crushing the operators' fingers.
[isolation inadequate, mechanical handling equipment]

Lessons

[None Reported]

Source : NEW SCIENTIST, 7 JULY 1988,; FIRE PREVENTION 205, DECEMBER 1987,; FIRE PREVENTION 210, JUNE 1988,; NEW SCIENTIST 26, NOVEMBER 1987,; NEW SCIENTIST 17, MARCH 1988,; SAFETY MANAGEMENT, JANUARY 1988,; HEALTH & SAFETY AT WORK, JANUARY 1988,; THE SAFETY PRACTITIONER, JANUARY 1988,; THE OBSERVER, 22 NOVEMBER, 1987,; THE GUARDIAN, 21 NOVEMBER 1987,; THE GUARDIAN, 24 NOVEMBER, 1987,; THE GUARDIAN, 3 DECEMBER, 1987,; THE LONDON EVENING STANDARD, 19 NOVEMBER, 1987,; THE TIMES, DECEMBER 2, 1987,; FIRE PREVENTION 215, DECEMBER 1988, FIRE PREVENTION 207, MARCH 1988.

Location : London, UK

Injured : 21 **Dead :** 31

Abstract

Thirty-one people died and twenty-one seriously injured in a major fire at King's Cross Underground Station.

The fire was most probably caused by a match discarded by a passenger who lit a cigarette. The match fell through a gap in an escalator onto an area below where there was an accumulation of dust, grease and papers. The fire initially was small and posed no life risk so passengers were diverted up a neighbouring bank of escalators as the fire brigade was called.

Approximately 20 minutes after the fire was discovered there was an extreme rapid build up of smoke and within seconds the blaze suddenly flashed over into the ticket concourse as a number of passengers were still ascending the adjacent escalator. The escalator was of a timber-clad type, 50 years old, being replaced at the time as part of a programme of modernisation. As the fire began there was a large amount of grease and detritus on the tracks of the escalator. The fire burnt unseen on the grease for up to 10 minutes before it was noticed and the escalator stopped. In all probability, the upward motion of the escalator spread the burning grease from the main seat halfway down the escalator. The fire then spread to other wooden sections of the escalator and onto the wooden hoardings and ceiling paint above and in the booking hall.

[fire - consequence, fatality, injury]

Lessons

The inquiry report made 157 recommendations, summarised into the following headings:

1. Escalators: to be fitted with heat detectors and the machine rooms with smoke detectors; these should activate alarm systems or sprinklers where appropriate.
2. Underground staff response: modern communication and message recording system required. Emergency and station closure plans must be agreed with emergency services and used in staff training.
3. Emergency services: to be provided with up-to-date station plans. The brigade and transport police to be consulted when alterations are planned.
4. Fire development: programme of replacement of wooden sections of escalators with metal; cleaning to be improved.
5. Management of safety: recommendations of internal accident reports to be considered at director level. Trade union participation in these inquiries should be encouraged. Fire equipment to be inspected regularly and defects remedied, including those found during annual fire brigade inspections. Total ban on smoking and investigation into passenger flow and congestion proposed.
6. Safety auditing: non-executive director with special responsibility for safety should be appointed. Safety audit system to be established.
7. Staffing and training: operations rooms must be adequately staffed at all times by trained personnel. Refresher training in fire and safety matters every two years for management and every six months for other staff.
8. Communication systems: to be improved and inspected regularly. Equipment used by British Transport Police to be compatible with the fire brigade's.
9. Fire certification law with respect to underground stations to be clarified. Secondary means of escape for existing stations and the costs of conversion to be identified. Research into fire characteristics of applied paint to be initiated.
10. Railway Inspectorate to be more vigorous in discharging its responsibilities under section 3 of the Health and Safety at Work etc Act 1974

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A fire occurred in an aluminium factory resulting in total destruction of the premises. There was evidence that the fire originated from a build-up of fine sawdust and discarded cigarettes and matches in the ground floor machine shop area. The building was last occupied over 12 hours before the fire occurred.

The fire took hold and progressed rapidly causing the roof and internal floors to collapse.

[fire - consequence, processing]

Lessons

1. Finely divided sawdust can smoulder for considerable periods before being ignited and causing a serious fire.
 2. Poor housekeeping and control of smoking on the premises are the cause of a significant number of fires.
-

Source : ICHEME**Location :** , NEW ZEALAND**Injured :** 1 **Dead :** 0

Abstract

An explosion occurred in the kerosene furnace whilst attempts were being made to relight it.

Relighting of the furnace is initially a manual operation which was being supervised by the team leader assisted by a process operator recently appointed to the unit. There were a number of unsuccessful attempts to relight the furnace before it was realised that the LPG bottle for the portable ignitor was empty. The shift controller who was now on the scene proposed that the furnace should be repurged. It was shortly after this that the explosion occurred. This resulted in the process operator receiving facial burns, lacerations and fragmented debris in his eyes when the observation window was blown out. Damage to the furnace was limited to the burner throat assembly plate and the expansion joint on the air inlet ducting.

Investigation of the incident did not determine the cause exactly as the actions of the process operator were not witnessed and he was not able to significantly contribute to the investigations as he was unable to recall the events. However the investigating team came to the following conclusions based on circumstantial evidence.

The main steam purge valve was found open and the second valve cracked open. As the process operator was new to the unit it was assumed that on hearing the shift controller propose the furnace be repurged he interpreted this as meaning steam purging the fuel oil burner, not air purging the radiant cell as was intended. It is believed that while the team leader and shift controller were engaged in obtaining a replacement LPG bottle the process operator steam purged the fuel oil burner. This would have released two/three litres of fuel oil into the hot radiant cell where it rapidly vaporised and ignited from the adjoining common convection bank with the crude distiller furnace.

[operator error]

Lessons

It is an historical fact that the majority of furnace explosions occur during attempts to relight a hot furnace because of human failure in following laid down procedures. This particular incident is no exception as the main reason for the furnace explosion involved the failure to adhere to the written operating procedures, i.e. to ensure that the ignitor was lit and in position prior to pressurising fuel oil into the hot furnace.

When persons are unfamiliar with equipment or a process it is imperative that they are properly supervised at all times, and that proper training in the appropriate procedures is given.

3975 24 September 1987

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 1987, 4TH QUARTER.

Location : Manila, PHILIPPINES

Injured : 14 Dead : 1

Abstract

An explosion occurred during discharge of methyl methacrylate monomer from a marine tanker to barge. Allegedly due to a man smoking on the barge. Fatality.
[unloading, cigarette, material transfer]

Lessons

[None Reported]

Source : ICHEME

Location : , SOUTH AFRICA

Injured : 0 Dead : 0

Abstract

A debutaniser reflux pump, which normally pumps LPG (mainly butane), had become blocked with hydrates. Whilst the pump was dismantled for maintenance, a solid deposition of ice and hydrates in the isolation valve was melted using a steam hose, allowing a major release of LPG. This was ignited on a near-by furnace and resulted in a vapour cloud explosion. The ensuing fire lasted for about 100 minutes and the fire consequences, were severe involving major damage to equipment, and a prolonged plant shut-down.

[training inadequate, safety procedures inadequate, fire - consequence, damage to equipment, plant shutdown]

Lessons

Training inadequate the properties of hydrates was not understood, and it was mistaken for ice. Safety procedures inadequate due to lack of understanding the exact point of release was not communicated to the emergency team for over 30 minutes.

Source : ICHEME**Location :** , UK**Injured :** 0 **Dead :** 0

Abstract

A fire started during a venting operation at the base of a reactor used for processing hydrocarbons on Monday 22 June 1987 at 1955 hours. It was fierce, but quickly extinguished by the fire service. There were no injuries. Damage was local and confined to instrument boxes and piping, cables and valve packing.

The reactor was being prepared for engineering work. In order to clear the contents and inert the vessel it was pressurised with nitrogen to 6 bar gauge and then vented to flare six times. The reactor was left sitting at 6 bar gauge pressure, and it was then decided to vent it again using a blanked off vent valve near the base. On opening the valve a small quantity of liquid emerged. The operator attempted to hose the spillage away. On contact with the water there was an immediate ignition.

Investigations suggested that a dead leg leading to the vent contained liquid hydrocarbon residues and fines of catalyst, which was metallic sodium. The water and sodium reacted violently and ignited the hydrocarbon.

[processing, maintenance, cleaning, reaction vessel, venting, vent, fire - consequence, sodium, water, hydrocarbon, catalyst, spill, cleaning procedure incorrect, cleaning inadequate, additional chemical present, competency lacking]

Lessons

1. Even apparently thorough purging of the reactor, hazardous materials can remain in dead spots within the reactor. The operators were to be reminded of this.
 2. Venting to atmosphere of streams containing catalyst is always going to be a potentially hazardous operation. In future this should be done to open areas, and the vent line exit submerged in water to deactivate the catalyst.
 3. Ways should be investigated for venting hazardous streams to a closed vessel.
-

Source : THE FIRES AND EXPLOSION AT..., A REPORT OF THE INVESTIGATION INTO THE FIRES AND EXPLOSION AT GRANGEMOUTH AND DALMENY
HSE REPORT, HMSO, 1989, ISBN 0118854933.

Location : Edinburgh, UK

Injured : 2 **Dead** : 1

Abstract

A fire was started in a large crude oil storage tank by a man smoking a cigarette within the tank. The men had entered the tank to clean out sludge. Fatality.
[fire - consequence, cleaning]

Lessons

An important safeguard during tank cleaning operations involving flammable residues is the provision of adequate ventilation. This should be sufficient to reduce the overall flammable vapour concentration, to avoid vapour pockets and to minimise the extent to which the vapour above the sludge surfaces may be in the flammable range. The effective control of ignition sources is of equal importance but in view of the ever present risk of fire, precautions for tank cleaning must also include provision for safe means of escape. Tank designers should give due consideration to the hazards of cleaning operations and the need for access and ventilation.

Companies who carry out tank cleaning operations should produce a detailed method statement setting out clearly the safety precautions they intend to take.

Source : ICHEME

Location : ,

Injured : 4 Dead : 0

Abstract

A leak of hydrogen sulphide gas occurred whilst a flange was opened up to remove a spade during the start-up of the catalytic cracker following a scheduled shut down. Four fitters working in the vicinity were overcome by gas, two of whom collapsed.

There was no material damage and the unit was started up as scheduled.

The start of the work to withdraw the spades was verbally authorised by the area supervisor to a maintenance supervisor, who initiated the fitters to start work at several locations simultaneously. The gas escape occurred when the flange in the line from the main fractionator overhead receiver to the flare line was opened to remove the 8" spade. The gate valve to the flare was already open, which was not realised by the fitters themselves.

The flange in question is located on a platform which is approximately 8 metres high and the platform is reached by a stairway and access ladder.

The fitter working directly over the flange lost consciousness. Three other fitters working in the same area on the removal of other spades tried to rescue the first one.

They also inhaled the escaping gas and a second man collapsed after they had managed to move the first fitter only a short distance. The other two fitters were themselves being affected and had to escape via the access ladder.

The flange was then closed by another fitter wearing breathing apparatus and the fire brigade organised transport of the four fitters to hospital after giving first aid with oxygen.

The precise composition of the flare gases at the time of the incident is not known. However an analysis of the flare gases the following day gave an H₂S content of 6.5 ml/100ml. Three men were released from hospital the following day and the fourth man two days later.

An investigation into the incident concluded that it occurred because of the normality of this work, repeatedly performed by the crew without any problems.

In this case the situation was different due to the fact that some delay in the start up procedure had caused the work to start during the shift changeover. The fitters were already waiting at the different locations for the sign to start withdrawing the spades. They started working after the verbal authorisation given to them from the maintenance supervisor, without waiting for an operator to come and supervise.

The operator would have checked the valve position and would have closed the valve and depressurised the line, so preventing the incident from taking place.

[gas / vapour release, blind/spade/slip plate, slip plate insertion/removal, cracking]

Lessons

Recommendations and Actions:

1. Authorisation for this special work will in future only be given in written form by a shift foreman.
2. Correct positions of the valves next to the spades to be checked immediately before work authorisation.
3. Work will only be performed under the supervision from unit operators.
4. Work will not be performed during the shift changeover.
5. Small technical modifications for improving identification and accessibility of spades to be carried out.

Source : ICHEME

Location : , FRANCE

Injured : 14 Dead : 2

Abstract

Several explosions occurred on a site, which is 30 years old, which contained three storage tanks for gas oil and fuel oil, 40 tanks for other products and 50 small tanks containing additives. A new additive tank was being constructed. The fire started at lunch time when there were only a limited number of persons on the site. Within a space of half an hour there had been three explosions including motor spirit additive tanks which spread debris over a wide area and enveloped numerous other tanks in flames. Six hours after the fire started a 1000 m3 tank containing gas oil boiled over and another four hours later two other tanks caught fire. Two and half hours after this there was a second boilover.

Eight hours later, which was approximately 21 hours after the incident started, all fires had been extinguished.

Approximately 10,000 m3 of product had been destroyed and 80% of the depot plus some emergency vehicles.

It is suspected that the cause of the fire was hot welding slag from the construction of the new additive tank. The welders had left the site for lunch and no fire watch was maintained although safety personnel were present. The depot did not have a fixed foam extinguishing installation. Fatality.

[contractor error, fire - consequence]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 **Dead :** 0

Abstract

Contaminated water spilled into a batch of vacuum filters after an operator hosed down a grated floor.

The operator was stopped and the filters were covered with plastic sheets. The batch was washed and then scrapped for safety reasons.

[contamination, operator error, cleaning]

Lessons

[None Reported]

Source : FIRE PREVENTION 206, JANUARY/FEBRUARY

Location : , UK

Injured : 0 Dead : 0

Abstract

A fire occurred at a warehouse storing 470 tonnes of barbeque charcoal, 1600 litres of lighter fuel.

The incident occurred when four employees were loading a vehicle. The building had no electric lighting available and it was getting dark. Barbeque candles were being used to illuminate the worker area. One of the candles was dislodged and ignited cardboard packaging and spread to other areas of the building. The fire brigade were called and the fire was eventually brought under control.

Estimated damage £2,676,000 (1987).

[fire - consequence, warehousing, safety procedures inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

During a plant emergency shut-down, a propylene condenser was vented down quickly below a "safe" pressure causing the propylene to boil off, the cooling water froze and burst several heat exchanger tubes.

[damage to equipment, safety procedures inadequate]

Lessons

The process control system needed to be reviewed to limit the venting rate or pressure to keep the heat flow high enough so that freezing of the water does not occur.

1069913 March 1987

Source : LLOYDS LIST, MAR 16, 1987,; THE TIMES, MAR 23, 1987.

Location : , UK

Injured : 2 Dead : 2

Abstract

Two maintenance contractors were killed removing a valve from a pipeline under repair. A hydrocarbon gas cloud escaped, this ignited resulting in an explosion and fire. Two other men were hospitalised with burn injuries.

[gas / vapour release, fire - consequence, vapour cloud explosion, burns, isolation inadequate, injury]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 080, 21.

Location : ,

Injured : 0 Dead : 0

Abstract

Two contractors were working inside the skirt of a butadiene plant distillation column. They were installing a clamp on a leaking process line flange. An entry permit had been issued and the men were wearing breathing apparatus supplied by a works trolley set.

The men came out of the confined space claiming that they were receiving an inadequate air supply. A replacement set was supplied and on this occasion the reduction in air supply occurred suddenly, such that the air masks had to be removed and evacuation took place immediately. The job was completed satisfactorily using a further trolley set.

After investigation the findings were as follows:

1. The sintered metal air filters in the air pressure regulators were blocked with debris, consisting of metal filings from the component fittings and slivers of teflon tape used on the component threads.

2. The filters were clearly old and appeared to be partially blocked with fine dust. There was no procedure for regular, periodic changing of the filters.

Similarly there was no procedure for checking the air flow using a rotameter on each occasion prior to issue.

As a result of this incident, procedures have been revised to ensure that the filters are changed annually and that proper records are maintained. Also to insure that a rotameter test is carried out on each occasion prior to issue of the equipment and the result recorded in an issue book.

[entry into confined space, maintenance, flange leak, testing inadequate]

Lessons

Excess tape was a factor in the blockage of the air filter.

Source : HEALTH AND SAFETY AT WORK

Location : Oldbury, UK

Injured : 6 Dead : 1

Abstract

A 12 year old boy died from burns sustained when he was engulfed by a fire ball when a propane cylinder exploded on a road works site.

Workers were cutting slots in the road to install sensor cables, when the cables were in place the slots were filled in with molten bitumen.

As the work progressed, the busy road became congested. This was due to the contractors van being in the way.

One of the contractors decided to move the van to help ease the congestion. In doing so, the free standing bitumen boiler in the back of the enclosed van fell over while it was still alight. A fire quickly developed and the propane cylinders became subject to intense heat. They subsequently exploded violently and two were propelled some distance away from the van.

One of the cylinders landed in the nearby car park and created a fireball which trapped the 12 year old boy who was watching the blaze. He sustained 90% burns.

[fire - consequence, maintenance, fatality, safety procedures inadequate]

Lessons

The following recommendations were made:

1. A boiler or cauldron should never be transported or towed with a burner alight.
 2. The ease of mobility of LPG cylinders and the fact that LPG when liquefied by pressure occupies a volume about 250 times smaller than that occupied by the gas at the same temperature, makes it an obvious choice for many applications. It is an economic, efficient and clean fuel, and can be found being put to many uses where mobile sources of heat or light are required.
 3. LPG is highly dangerous unless it is carefully, and paying due regard to the proper storage and transport of cylinders.
 4. Attention to all parts of various appliances to check for leaks and for the exclusion of sources of ignition.
-

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

A fitter was struck by falling scaffolding poles. The poles fell from a load of scaffolding material which was being lifted by a crane up to an elevated walkway during a major overhaul. The fitter received severe bruising to his right elbow.

In order to perform a modification to instrumentation a scaffolding platform had to be constructed adjacent to an elevated walkway (30ft above ground) at fin-fan headers. All scaffolding required for the overhaul was being handled by a contractor and a foreman arranged for the use of a crane working in the area lifting heat exchangers to lift scaffolding tubes and boards up to the fin-fan walkway. In all four scaffolding boards and ten poles were required to build the scaffold.

When the crane became available to make the lift a rigger went in search of short slings as those already on the crane were too long and too highly rated for the lift and he doubted if they would be able to "bite" the scaffolding adequately. Whilst he was searching for the correct slings he noticed that the scaffolding gear had started to be lifted as a single bundle.

It transpired that while the rigger was away two of the scaffolders and a supervisor had rigged the scaffolding equipment as a single load using one of the long slings already on the crane hook with half hitches at the end of the load.

The load was lifted having checked for stability but the crane jib was too short to be able to land the load on the walkway.

While the crane driver was lowering the load for re-rigging it hit the underside of the walkway. This tilted the load and the scaffold poles fell vertically. The fitter working underneath, who was unaware of the lift, ran clear of the area when he heard a "clanging sound" from above. Nevertheless he was hit directly on the elbow from a falling pole and received glancing blows on the head and buttock from other falling poles. A scaffold board on which he had been working was pierced through by a falling pole.

The following conclusions were made:

1. The load was inadequately rigged.
2. The wrong types of slings were used both to allow the lift to be successfully completed and to bind all the equipment tightly.
3. Two slings should have been used.
4. Scaffold boards and poles should not be lifted together.
5. Lifting both allow the boards to assume a diamond arrangement or other similar patterns to be set up in the load which prevents the poles being held tightly.
6. Checks to ensure that all personnel were away from the area were not carried out.
7. The rigger who was designated to carry out the work was overstepped by other personnel, who used equipment which the trained rigger had deemed unsuitable.

[maintenance, safety procedures inadequate]

Lessons

The following recommendations were made:

1. Only suitably qualified and identified personnel must be allowed to rig materials for lifting.
2. Scaffold boards and poles must not be lifted together.
3. Areas below lifts must be thoroughly checked to ensure they are evacuated.

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

At the start of some maintenance work to repair a small leak in one of the finned tubes of a finned fan condenser, the removal of a plug released liquid hydrocarbons.

This liquid fell onto hot residue pumps (350 degrees C) some 10 metres below and immediately caught fire. This fire took about 30 minutes to extinguish and one of the maintenance fitter sustained minor burns to his left forearm.

The incident was caused by not ensuring that the tube bank of the finned tube cooler had been completely drained of hydrocarbon liquid before removal of the plug. It was noted from the investigation into the accident that the fitter completed the removal of this plug even though some liquid had been released when the plug was initially loosened.

Shortcomings were found in communications and in adequately recognising the hazards associated in the preparation of this equipment for repair. Proper procedures to ensure the condenser was completely drained had not been prepared prior to the start of the work.

[spill, draining of line insufficient, hot surface, fire - consequence]

Lessons

1. The importance of properly detailed procedures must be emphasised for all special, non routine jobs.
 2. Specific, non routine operation jobs to be accompanied with clear instructions with a detailed sequence description containing every detail of the operation. Those instructions to be discussed with all concerned carrying out the job before the job is executed.
 3. Drain facilities to be provided on the outlets of the airfin bank sections in order to carry out similar operations safely in future.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

Within a contractor's compound at a refinery an explosion damaged a vacuum cleaning road tanker and a contractor's employee was killed. The explosion was caused by the contractor's employee deciding to repair a leaking nozzle on the tanker by welding without first ensuring that the tank had been purged of flammable vapours. The full diameter end cover of the tank was blown a distance of about 12 metres by the force of the explosion which was followed by a short fire. The contractor had a general permit for "hot work" within its compound.

The investigation following the accident made it clear that the cleaning contractor had been carefully vetted before selection; all the individuals involved had received safety training and had 3 to 4 years experience on the site, the contractor had been given instructions requiring an additional "hot work" permit to be obtained for this type of work. In spite of this those directly responsible for this particular job did not realise the hazards involved nor did they see any need for an additional "hot work" permit. Fatality.

[contractor error]

Lessons

This accident is a tragic reminder to all those in charge of similar operations that they should ensure that contractors and their employees operating vacuum cleaning tankers and similar equipment within petroleum sites are fully aware of the hazards they face and the need to abide strictly by all safety procedures.

Source : LOSS PREVENTION BULLETIN, 091, 16.; ICHEME

Location :

Injured : 0 Dead : 0

Abstract

A release of propylene gas occurred when an instrument technician unscrewed a thermowell from a compressor by mistake.

The escape continued for 10 minutes and resulted in the plant being shut down. The gas cloud did not ignite.

The instrument technician had already successfully removed one low temperature alarm probe capillary tube from a compressor.

He then proceeded to remove the tube from another low temperature alarm. He first slackened nut No. 1 which is a compression fitting on to nut No. 2. He then

went on to slacken nut No. 2 which unfortunately was seized to nut No. 3 (which is part of the thermowell) and unscrewed the thermowell. He mistakenly believed that he was working on a flanged thermowell similar to a type fitted to an adjacent compressor in which the thermowell is integral with the flange.

[operator error, gas / vapour release, temperature meter/control, plant shutdown]

Lessons

It is obviously essential that technicians are fully aware of the construction details of equipment on which they are working particularly when there are important fabrication differences between otherwise similar fittings as in this case.

Abstract

A rail transportation incident. A train of three locomotives went through a stop signal and intruded onto a high-speed rail line. Seconds later, a passenger train collided with the locomotives at a speed of 102 mph.

Three crewmembers of the locomotive train showed evidence of marijuana use, possibly coupled with the use of alcohol. The crewmembers had:

1. Failed to respond to restrictive signals.
2. Failed to resolve the problem of an inoperative radio.
3. Failed to make pre-departure tests of brakes and cab signals.
4. Exhibited delayed throttle responses.
5. Ignored wayside signals whilst preparing lunch.

[collision, fatality, safety procedures inadequate, drug misuse, design inadequate, injury]

Lessons

The NTSB issued a large number of recommendations to the two train operators involved, including:

1. Better methods of identifying employees who abuse alcohol and/or drugs.
 2. Installation of automatic train control on all locomotives.
 3. Improved crashworthiness of passenger cars.
-

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 2 **Dead :** 2

Abstract

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 supposedly isolated from other working parts of the flare system and supposedly drained and tested. As a ring spacer on the gate valve was pulled free, torrents of petroleum spirits gushed out, igniting on a nearby air compressor engine used to supply air for the breathing apparatus of the maintenance crew. The scaffold platform and persons on it were enveloped in flames.

The refinery fire brigade were quickly on the scene and soon afterwards the local fire brigade arrived. The fire was readily confined to the valve area. There was never a possibility of effects external to the refinery site. Fatality.

[hot surface, fire - consequence, spill, operator error, refining]

Lessons

1. Work on the flare system has to be authorised at senior management level, valves should have an indication of their position.
 2. Changes in work methods are also needed, verify the performance of flare drainage.
 3. Purge lines with inert nitrogen gas to clear residual flammable gases and to prevent air from reaching a pyrophoric scale inside.
 4. Move flanges apart gradually with bolts still in position until the content of the line can be identified for certain; - use trays under the flanges as they are moved apart to collect liquids in a safe way.
 5. Alternative escape routes from scaffold platforms or any work area must always be available.
 6. Staff on the work must be equipped with flash fire suits, remove persons away when the final lift is carried out;
 7. Drench the valve removal area and scaffold platforms with ground-level fire monitors as the lift is carried out.
 8. Provide a refinery fire tender on stand-by at the scene.
 9. Avoid diesel engine-operated compressors nearby, at locations to which the air system does not extend, mobile air storage tanks will be provided for breathing apparatus.
-

123561987

Source : ICHEME

Location : ,

Injured : - **Dead :** -

Abstract

An incident occurred when a tandem lift using a 50 tonne and a 30 tonne crane to lift a launch out of the water. In attempting to slew both cranes together to position the ramp, as the launch moved, the 50 tonne crane became unstable and its rear lifted off the ground as the launch plunged back into the water. [transportation, plant / property / equipment, safety procedures inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

A worker was seriously injured during movement of a crane platform.

The incident occurred when the crane controller did not see the worker as the worker was standing outside the crane platform railing. He became trapped between the platform and a vertical wall stanchion and suffered a fractured pelvis and internal injuries as a result.

[safety procedures inadequate, injury]

Lessons

[None Reported]

123581987

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

A fitter was seriously injured when he was struck in the groin and lower abdomen by a water jet, which caused serious injury.

The incident occurred during pressure testing when a 20-metre section of a 20-inch firemain required the insertion of a spool piece. When the pressure reached 10000 kPa one of the end caps failed. The blank flange tore away from the spool piece over approximately 170mm of the circumference and water sprayed out violently inflicting serious injury to the fitter nearby.

[mechanical equipment failure, pipe, safety procedures inadequate, injury]

Lessons

[None Reported]

123541987

Source : ICHEME

Location : ,

Injured : - Dead : -

Abstract

A pedestal crane suddenly tilted forwards due to the failure of bolts on the rear hook roller housings.

An investigation into the incident found that the bolt material was of low quality steel and there was a possibility that they had been insufficiently torqued.

[bolt failure, material of construction failure, plant / property / equipment, safety procedures inadequate]

Lessons

[None Reported]

123591987

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

An explosion and fire occurred in a vacuum tank. The incident occurred after a leak was discovered at the suction nozzle. The repair was made during arc-welding a piece of metal over the leak when the explosion occurred causing the end cover to be blown off. The fitter carrying out the repairs died as a result. [fire - consequence, hydrocarbon, fatality, safety procedures inadequate]

Lessons

[None Reported]

123551987

Source : ICHEME

Location : ,

Injured : - **Dead :** -

Abstract

A crown ram failed on a 20-tonne crane as it was unloading a container weighing 17 tonnes. The load was subsequently dropped on the back of the crane.
[mechanical equipment failure, plant / property / equipment, safety procedures inadequate]

Lessons

Source : ICHEME

Location : ,

Injured : - **Dead :** -

Abstract

An incident occurred during the erection of scaffolding to the top walkway of a furnace when the scaffold suddenly tilted forward resulting in workers falling to the ground.

Both workers were wearing safety harnesses, which had been attached to the north side vertical scaffolding poles. When the platform pivoted, the slings slipped off the now downward pointing poles.

An investigation into the incident found that the scaffolding was secured only to the walkway railing. The two north side vertical poles should have been fastened to the furnace structural beam before the actual work started.

The only resistance against the pivoting movement created by the weight of the two workers, was the friction exerted by the clamps attaching the south side vertical poles to the walkway railing.

[fall, construction, safety procedures inadequate, design or procedure error]

Lessons

[None Reported]

123661987

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

Argon arc welding operations were being carried out on a 30-inch stainless steel pipe. To minimise argon usage, temporary dams were build inside the pipe on each side of the welding area.

After the welding was completed the bolermaker, wishing to inspect the welding, enetered the pipe. He crawled 5 metres into the pipe, removed the dam and entered the argon rich area, where he was asphyxiated.

Desparate rescue attempts were made but the boilermaker died.

[inspection, asphyxiation, fatality, safety procedures inadequate]

Lessons

[None Reported]

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

The operation of this plant was organised in two shifts. Since this hydrogenation reaction would have taken at least 30 hours to complete, it was shut-down in the normal way (shutoff of hydrogen supply, turn-off of agitator). No nitrogen inerting was used. The control panel of the reactor showed a normal operating temperature and pressure after shut-down. 10 minutes later, as operators were changing in their locker room, an explosion occurred, followed by a fire around the reactor. A second explosion occurred a few minutes later and a fire with a characteristic black smoke resulted. The fire was extinguished by the automatically activated sprinkler system. One reactor and attachments were destroyed, glass apparatus on nearby reactors also damaged, windows up to 30 m away blown out. Investigations showed that the pressure relief line of the reactor did not operate, the bursting disc being found to be intact. The explosion was attributed to agitator malfunction (its maintenance records showed that it has malfunctioned on numerous occasions) allowing hydrogen to leak. The ignition source could have been any of the nearby located electric installations, not suitable in a hydrogen atmosphere.

[reactors and reaction equipment, electrical, operator error]

Lessons

1. To carry out hydrogenation in a separate dedicated process area with electric equipment suitable for use with hydrogen.
 2. To provide adequate alarms to warn when there is a hydrogen leak. The company was also required to implement a more extensive preventive maintenance system.
 3. Install appropriate pressure relief devices to ensure that emissions do not vent into the process area.
 4. Review procedures to ensure that processes, which have to be left unattended overnight, are left in a safe state.
 5. Provide nitrogen inerting in any reactor containing highly flammable solvents which have to be left unattended overnight.
-

Source : ICHEME

Location : , UK

Injured : 0 **Dead :** 0

Abstract

The motor operator was to be removed from an LPG valve for repair. However, the maintenance man started to remove the nuts holding down the valve bonnet rather than the topworks. A serious leak resulted. Fortunately it was possible to block in the line containing the valve.

[preparation for maintenance, automatic valve, blowout, maintenance procedure error, contractor error, spill]

Lessons

1. Maintenance men must either be very familiar with the detail of all the equipment they work on or be shown exactly what they are required to do on each job.
 2. With the great increase in use of contract maintenance the former is more difficult to achieve
-

1129601 November 1986

Source : THE TIMES, 3-4 NOV, 1986.; THE INDEPENDENT, 3 NOV, 1986.; LLOYDS LIST, 3 NOV, 1986.; UNITED PRESS INTERNATIONAL, 2 NOV, 1986.; PRESS ASSOCIATION, 2 NOV, 1986.

Location : , BULGARIA

Injured : 19 **Dead :** 17

Abstract

An explosion occurred at a chemical complex, which killed seventeen people and left nineteen requiring urgent medical attention, was believed to have been caused by a ruptured pipe. Unofficial reports stated that the large number of injuries and fatalities was as a result of a plant malfunction being investigated at the time of the accident.

In a later press release, it was revealed that the management of the country's chemical industry had been summarily dismissed for incompetence when it was discovered that a lack of safety checks may have contributed to the incident. An interim body was appointed until a new management structure could be set-up [mechanical equipment failure, safety procedures inadequate, fatality, injury, processing]

Lessons

[None Reported]

3761 28 October 1986

Source : MARINE ACCIDENT REPORT, EXPLOSIONS AND FIRES ABOARD THE U.S. TANKSHIP, NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, REPORT NUMBER NTSB/MAR-87/06, 1987; THE EVENING SUN, 1986, 30 OCT.

Location : Honolulu, HAWAII

Injured : 0 **Dead** : 4

Abstract

A marine transportation incident. Explosions and fire occurred in the engine room and starboard fuel oil tanks of this marine tanker. It was not carrying cargo at the time. The probable cause was hot work being carried out igniting combustible vapours escaping from the after vent for the starboard fuel oil storage tank. In addition tank vent screens were not properly installed and maintained, and the fuel oil was not of the correct flashpoint. Fatality.

[fire - consequence, installation inadequate]

Lessons

[None Reported]

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, D.C. 20594, VOL 6, NO. 9.

Location : , USA

Injured : 0 Dead : 2

Abstract

A marine transportation incident took place at a marine terminal. A marine tanker was discharging a cargo of acetone, and two tank barges were discharging methyl tertiary butyl ether. An idle hose lying on the dock suddenly developed a kink and ruptured. A white vapour cloud formed and exploded, engulfing the dock, the ship and one of the barges. The first officer of the ship and a dockworker were fatally injured: the fire on one of the barges lasted for 5 days. (The dockhand had no reasonable means of escaping from the fire).

It was established that the 'idle' hose which caused the incident had been left full of propylene after partially discharging another tanker. Instead of being disconnected and purged (in line with procedures) the line had been left full of propylene and capped. It had apparently ruptured below its design pressure (several dock hands testified that they had noticed the hose was worn, but did not report it).

[material transfer, explosion, fire - consequence, training inadequate, safety procedures inadequate, inspection inadequate, gas / vapour release, fatality]

Lessons

The NTSB concluded that the incident would not have happened if the terminal operator had followed its own procedures (ie emptied and purged the 'idle' hose). The NTSB made a number of recommendations, including:

1. The requirement that persons in charge of transfer of hazardous materials should be certified.
 2. The establishment of effective means of protection or escape for those in charge of hazardous materials transfer.
 3. Improved procedures for checking that hoses are adequately rated for their duties, and for regular inspection for damage.
-

11261October 1986

Source : THE SAFETY PRACTITIONER, OCT, 1986.

Location : ,

Injured : 1 Dead : 0

Abstract

An industrial painter died of burns whilst painting the inside of a pipe 1.37 metres diameter on a hillside slope of a gradient of 1 in 4. A LPG gas powered lamp used for illumination inside the pipe was knocked over and rolled down setting a paint tray alight. The paint contained thixotropic gelled bitumen with a flash point of 32 degrees C.

The owners of the site had dewatered the pipe and issued a permit to work. The contractors had specified that low voltage flame proof lighting would be used. The painter attempted to get past the flames to the exit but his paint soaked overalls were ignited. The contractor was fined £1250 (1986).

[contractor error, hot work, injury]

Lessons

Use correctly specified low voltage flame proof lighting when working in confined spaces.

Source : THE SAFETY PRACTITIONER, OCT, 1986.

Location : , UK

Injured : 0 Dead : 1

Abstract

A security guard on a motorway construction site was killed on the night shift by carbon monoxide poisoning. He and his alsation dog were found dead in an office. A propane-filled radiant heater, which had been provided by his employer, was also in the office. The heater had an output of 11.8 kW and was designed to be used outdoors or in very large well ventilated buildings.

The ventilation in the office was inadequate for the heater. The gas inlet nozzle was partially blocked and the surrounding area was encrusted with mud. The result was incomplete combustion of the propane and build-up of carbon monoxide. The man's employer was prosecuted and fined £1500 (1986).

[safety procedures inadequate, fatality]

Lessons

The following recommendations were made:

1. Heaters used in small offices must be designed to be used in such rooms.
 2. Heaters used in small offices should be properly maintained.
 3. Small rooms containing heaters should be adequately ventilated to ensure that the oxygen content does not drop.
 4. Permanent ventilation openings in a room should never be blocked up.
-

Source : ICHEME

Location : , UK

Injured : 15 Dead : 0

Abstract

A road transportation incident. Fifteen firemen and police officers were treated in hospital after a lorry carrying 29 cylinders of pressurised methyl bromide caught fire. Arson or a discarded cigarette may have been responsible. One cylinder exploded and another became dangerously overheated. The people fighting the fire were unaware of the potential hazard.

[fire - consequence, explosion]

Lessons

[None Reported]

Source : ICHEME

Location : , HOLLAND

Injured : 0 Dead : 0

Abstract

During a major Fluid Catalytic Cracker Unit (FCCU) overhaul, a four level platform scaffold inside the regenerator vessel collapsed. Although five persons were working on the top platform at the time of the collapse nobody was injured.

The scaffold had been built to allow removal of refractory in the base of the regenerator.

It was meant to be used by five refractory workers and had, accordingly, been designed to a loading of 150kg/m² (about 1200kg in total). A central dump tube was incorporated into the scaffolding to facilitate removal of refractory debris.

At the same time as the refractory was being removed, a group of 15 workers began to remove sleeves from the regenerator standpipes which entered the regenerator vessels immediately above the scaffold. They used the scaffold for access and to support the standpipe sleeves, weighing about 2500kg before they were lifted free of the regenerator. Because the scaffolding platforms were not a close fit against the regenerator wall, displaced refractory was able to fall down and collect on the lower platforms. In any case removal of the standpipe sleeves prevented access to the central dump nozzle.

Some thirteen hours after work began the scaffold collapsed.

This was despite the fact the several persons noticed that some scaffolding tubes had bent during the period between commencement of work and the time of collapse.

It is clear that the scaffold became overloaded by virtue of it having been used to support heavy standpipe sleeves twice the weight of the scaffold design loading plus most of the removed refractory.

[cleaning, reaction vessel, maintenance, safety procedures inadequate, fluid cracker]

Lessons

Overloading of scaffolding is something which can have extremely serious consequences.

It is important that the contractor's supervisors are made fully aware of the dangers of overloading scaffolding and have sufficient scaffolding inspectors to monitor work on scaffolds.

Any departure from the normal, however apparently insignificant, should be immediately reported to supervisors.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

An explosion occurred within an electrical motor associated with an ethanol plant main gas scrubber. There were no injuries to personnel, but the force of the explosion detached one of the cooling exchangers and projected it a distance of 10-12 feet. The cause was inadequate lubrication of the NDE (non drive) end bearing of the motor in a probable sequence as follows:

1. Due to an over right in lubrication schedules, the motor oil level deteriorated to the extent that the NDE bearing assembly itself deteriorated (due to under lubrication).
2. This led to damage to the motor shaft sleeve (cracked welds).
3. Lubricating oil flowed through these cracks to the hot sleeve, oil possibly exceeded its flash point.
4. The oil was dispersed as a mist by the fan.
5. Metal NDE assembly parts reached a temperature high enough to ignite the hot oil mist.
6. The motor contained to run until the NDE bearing seized and tripped the pump on electrical overload.

[maintenance inadequate, damage to equipment]

Lessons

The main recommendation was to review lubrication schedules for electrical equipment and procedures for their implementation, right across the factory. In addition, further safeguards against the possibility of lubrication failure, extending to installation of an alternative design of motor, if necessary, were recommended for consideration.

Source : ICHEME

Location : , BELGIUM

Injured : 1 Dead : 0

Abstract

Whilst dismantling some old temporary buildings in a construction yard, one man was injured when the building frame collapsed onto him. The men were on-site without the knowledge of the site supervisor, and were not experienced in dismantling buildings. The structural design of the frame was deficient, in that there were no bracing angles, and also the wooden frame had become rotten and incapable of maintaining integrity.
[demolition, temporary equipment, training inadequate, design inadequate, injury]

Lessons

The lessons relating to the accident recorded in the report were:

1. Unauthorised access to site - refresh Gateman's instructions.
 2. No safety awareness instruction.
 3. Revised Engineering Dept procedure to ensure the earlier removal of "sheds" before rotting starts.
 4. Lack of experience was the main cause, with the structural problems contributing.
-

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

A scaffolder entered the plenum chamber of a finned fan heat exchanger of a plant after being issued with a handover certificate (cold work permit) and an entry permit for the confined space. While the scaffolder was placing boards over the air aperture the steel deck plate on which he was standing gave way and he fell 37 feet on to the hardcore ground. No bones were broken, but the scaffolder was hospitalised.

The following conclusions were made:

The accident was a case where initial design weaknesses coupled with a deteriorating condition resulted in the deck plates becoming unsafe for use as a walkway. Access to the area was infrequent and was controlled by an Entry Permit. The hazard had gradually worsened due to adverse operating conditions.

[entry into confined space, fall, design inadequate, safety procedures inadequate, scaffolding]

Lessons

1. All activities in plenum chambers, ducting etc. which utilise the deck plates as a walkway should be reviewed to ensure that the design is adequate and that the condition of the deck plates, etc. makes for safe entry and where not suitable, appropriate alternative methods are made available and warning notices employed.
 2. Consideration should be given at the design stage to improvements of chamber, plenums and ducts, either to avoid the need for entry or where necessary, to ensure incorporation into the structure.
 3. Review site practices with respect to checking the structural condition of walkways/access ways before the issue of Entry Permits.
-

3708 18 August 1986

Source : HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1986, 5 SEP.

Location : Newark; Delaware, USA

Injured : 9 **Dead :** 0

Abstract

An explosion and fire occurred in a pharmaceuticals factory. Wall and roof of 2 storey building blown-out. Said to be due to operator error in mixing process. The fire consumed approximately 3 000 pounds of chemicals, including glycerine, iodine, nitro amino anisole, and 100 pounds of sulphuric acid.
[fire - consequence]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

A fitter fell from the flat roof of a single story extension to a larger building whilst taking measurements for the installation of a safety rail which was to form part of a fire escape from the upper storey of the adjoining building. He sustained a fractured femur and cracked bones in his back and foot and was off work for several months.

A safety rail was fabricated and prepared for installation. The fitter, who had informed his supervisor that he was to commence the installation, went on to the roof to fix the new safety rail and whilst estimating the distance of the wall fastenings from the south face of the building fell down the light well. No suggestion of poor weather, slippery roof surface or other physical feature can be made as a contributory factor. Following the fall, which was fortunately noticed by persons working in offices looking into the light well, some difficulties were experienced in extricating the injured fitter since there is no door access into the light well.

[safety procedures inadequate, permit to work system inadequate, injury]

Lessons

In this case the job was not covered by a work permit although the site does employ a work permit system for process related work. While, under some circumstances a work permit system may not be applied to non process related building works, the hazards of working at heights make it necessary to institute a checking routine by supervisors and the discipline inherent in the work permit system of identifying hazards and stipulating precautions to be taken may be the best way of achieving this.

Source : ICHEME**Location :** , FRANCE**Injured :** 0 **Dead :** 0**Abstract**

A furnace was shut down and the convection section modified in order to be able to use hard profile heating for ethane cracking. The previous method of measuring naphtha flow for cracking using vortex flow meters was rather unreliable and it was decided to examine the pipework supports to get rid of constraints on the measuring instrument. The pipework was blanked, drained and steamed out and a valve opened at a low point. There was a delay in the work due to problems in the interchangeability of the vortex meters. A solution was found, the pipework modified and the vortex meters changed. When the work was completed the burners were lit to dry out the furnace and to test the system. Deblanking took place and the start-up commenced. When naphtha was introduced into the furnace a leak occurred followed by a fire. Flames reached the height of the chimneys. The unit was rapidly shut-down with burning of many electric and control cables on many furnaces, one furnace had had the casing and structure distorted. Another furnace had the convection section distorted and a crane had its motor and electrical circuits destroyed. On investigation the naphtha line flange was found to be loosened instead of the usual practice of removing three bolts and rotating the section downwards. The space between the loosened flange was not noticeable from the ground. The valve in the naphtha line is maintained open by air pressure from an electrically operated valve. When the fire occurred the naphtha valve was shut from the control room but the cable to the electrically operated valve was burnt and the naphtha valve re-opened. Subsequently the body of the electrically valve was melted and the naphtha valve closed again. The work on the vortex valves normally took 3 days but in this case it had taken 3 weeks.

[modification, inspection inadequate, start-up, fire - consequence]

Lessons

The following lessons were learnt:

1. The manual trip valves for isolation were inaccessible and were involved in the fire.
2. The cables were in a vulnerable position.
3. Walkie-talkies had to be used as they were the only means of communication as the cables were burnt. However only three were available.
4. 25% of the connection pipes, copper connections, gas copper connections to the burners gave rise to slight leaks.
5. Test of air tightness would be carried out before start-up.
6. Checklist system to be introduced.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An incident occurred when the air supply to air line breathing apparatus being used by four contract employees working inside a tank totally failed. The four men had to remove their breathing masks and escape from the tank without respiratory protection. Fortunately no harmful effects were experienced.

Air line breathing apparatus being used during the application of a protective lining inside a storage tank was supplied by a diesel engine driven air compressor connected to a breathing air filtration (BAF) unit. This particular unit consists of water separation and filtration systems plus four high pressure emergency breathing air bottles all mounted as a two-wheeled trolley unit.

It is designed to supply four persons from individual hose connectors at a breathing air manifold.

The design of this BAF unit incorporates an automatic change-over between normal and emergency air supplies. Should the air compressor supply fail an alarm is provided to alert standby personnel that the change-over has taken place. The unit also has the facility to prevent air reaching the outlet manifold if an attempt is made to commission the BAF with the emergency breathing air bottles empty. Conversely, however, should the emergency breathing air bottles become exhausted while the unit is in use the control system would automatically stop the flow of air to the breathing masks even though the air compressor continues to run normally. No alarm is provided to warn of decaying pressure in the emergency breathing air bottles.

This BAF unit was delivered to site by a contractor as part of a package of equipment required for the tank lining work. When an attempt was made to commission the unit the incident occurred, but at that time no persons were actually using the air line breathing air equipment. On subsequent inspection the following faults were found:

1. Damaged air hose
2. On/off switch inoperable
3. Emergency air bottles empty

Following repairs by the equipment manufacturer the BAF unit was commissioned and entry made into the tank with air line breathing apparatus.

On the following day the incident occurred. Subsequent inspection of the BAF unit indicated that:

1. The air compressor was still running.
2. No audible alarm had sounded.
3. The emergency air bottles were empty. In order to progress the work the breathing air system was reinstated using two independently running air compressors plus a standby compressor.

[entry into confined space, safety procedures inadequate]

Lessons

There was a design fault in the system:

1. Start up and normal operation, The unit cannot be brought into operation unless the emergency air bottles are pressurised and the valves open. This is acceptable.
2. Failure of air supply from the compressor. Audible alarm sounds and air is supplied from the emergency air bottles sufficient for about 30 minutes supply for 4 persons. This is acceptable.
3. Loss of air pressure in the emergency air bottles. Outlet from the BAF unit is automatically closed without warning even though the air can still be running. This completely unacceptable and has to be modified.
4. Air supply for breathing apparatus as used by contractors must always be checked for suitability.

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, D.C. 20594, VOL 6, NO. 7.

Location :

Injured : 3 Dead : 1

Abstract

A rail transportation incident. A freight train travelling at 40 mph collided with the rear of another freight train which was stopped on the same track, killing the brakeman in the 'caboose' and injuring three other crew members. The locomotive cab was destroyed on impact.

There was dense fog at the time, but the engineer of the first train apparently ignored speed restrictions (displayed in the cab) because of the large number of (spurious) speed restriction signals displayed on this and previous trips. He acknowledged the signals and thus over-rode the automatic train control system.

The NTSB said that 40 mph was too fast for the engineer to see and interpret wayside signals under the foggy conditions. Numerous rule violations were committed by the crews of both trains.

[fatality, collision, fog, operator error, safety procedures inadequate, design inadequate, injury]

Lessons

The NTSB called for:

1. Improved design and construction of locomotive operating compartments to provide adequate crash protection (this had been recommended 15 years earlier as a result of a previous crash).
 2. Better maintenance procedures to reduce the level of false speed restriction signals
 3. Better supervision of adherence to operating rules, including monitoring of speed tapes and event recorders.
 4. Installation of a train control system which would provide for positive separation of trains.
-

Source : LLOYDS LIST, 30 JUNE, 1986.

Location : Oklahoma, USA

Injured : 0 **Dead :** 1

Abstract

An explosion occurred at a uranium processing plant. Workers overfilled a steel cylinder with uranium hexafluoride. The cylinder ruptured, sending a cloud of radioactive particles for several miles.

[material transfer, operator error, radioactive release, fatality, overflow, gas / vapour release]

Lessons

[None Reported]

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, D.C. 20594, VOL 6, NO. 4.

Location : , USA

Injured : 0 Dead : 0

Abstract

A marine transportation incident. A bulk cargo ship collided with a fleet of moored barges on the Mississippi river causing \$1.4 million (1986) damage. The collision occurred on a clear night whilst the ship was southbound for New Orleans.

The pilot was attempting to overtake two tow-boats travelling abreast, on a bend where width was restricted, despite a caution from the operator of one of the tow-boats. In addition, although radar was available, inadequate use was made of it.

The pilot had had five accidents within two years - one of these involved excessive speed of the ship he was piloting.

[marine freighter, operator error, safety procedures inadequate, collision, damage to equipment]

Lessons

The NTSB said it was "concerned about oversight of pilot performance and its effect on navigation in US waters". It recommended that:

1. Effective use must be made of radar.
 2. The mooring of barge fleets on river bends should be prohibited.
 3. Pilots should avoid passing tows on river bends wherever practicable.
-

1200718 June 1986

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A rail transportation incident. A slight leak was reported on the dome of a rail tanker containing acetonitrile at the loading line flange. Emergency teams attended the site and repointed the valve.

[environmental, leak, maintenance inadequate]

Lessons

[None Reported]

Source : FIRE PREVENTION NO. 198, APRIL 1987.

Location : , UK

Injured : 0 Dead : 0

Abstract

A fire occurred in the textile part of a large industrial building.

The fire occurred due to waste paper and cartons being ignited, possibly by a discarded cigarette end. The area contained a large quantity of flammable materials.

[fire - consequence]

Lessons

[None Reported]

Source : LOSS PREVENTION BULLETIN, 074, 23-27, 080, 31-34.

Location : ,

Injured : 1 Dead : 0

Abstract

During unloading of a road tanker filled with 89% nitric acid to a storage tank, it was noted by the pump operator that the nitric acid delivery was "warm". Unaware of the significance of this fact, the unloading operation went ahead, and he did not report the apparent high temperature of the nitric acid. The operator also observed that the nitric acid seemed "warm" when preparing for feed to the nitrator. He reported the apparent abnormal acid temperature to his foreman. None of the people involved with the nitric acid handling on the day of the accident knew what the normal temperature of the acid should be. There was immediate concern by the process operators that there was a chemical reaction occurring in the nitric acid storage tank. For this reason the nitric acid in the measuring tank was dropped back to the outside storage tank.

A rumbling noise was then heard coming from the nitric acid storage tank. A sample of nitric acid taken from the pump showed the presence of an abnormal brown oily layer in the acid. These observations were constructed as evidence that there was a chemical reaction occurring in the nitric acid storage tank.

Because of the reactive nature of nitric acid, it was decided to drain the tank to the contaminated . When gravity draining was too slow, use of the transfer pump to speed up the emptying of the tank was attempted.

The transfer pump would not start, and two fuses in the motor circuit were replaced by the foreman. It is standard procedure throughout the plant for production personnel to replace blown fuses in motor circuits. The pump still would not start, and the foreman summoned an electrician to check the pump electrically. The electrician checked the three phases for grounding and electrical continuity. Electrically, the pump was fine. The fuses were replaced by the electrician. When the pump was restarted an explosion occurred.

The foreman present at the time suffered multiple fractures to both bones of the right leg below the knee as the pump exploded.

Laboratory work determined that the cause of the explosion was the reaction between the nitric acid and the copper windings of the pump motor. Nitric oxide gas was formed, generating high gas pressure within the pump. The welds on the stator housing gave way and hurled the end flange at high velocity towards the foreman. In addition, there was a chemical reaction between the silicone fluid which immersed the electrical windings of the pump and the nitric acid.

However, this is unlikely to have significantly contributed to the explosion. It was decided that the polymeric material observed in the nitric acid samples taken prior to the explosion were probably the product of that reaction. The contaminated samples did not represent the nitric acid storage tank, but rather what was in the pump.

It is concluded that the rumbling noise heard coming from the nitric acid storage tank prior to the accident was probably from the nitrogen bubbler used for the level indication in the tank.

Subsequent to the accident, the supplier of the nitric acid indicated that the shipping temperature of the acid was likely to be warm, 55 to 60 degrees C (130 to 140 degrees F.)

The principle causes of this accident were:

1. Inadequate communication of maintenance information between the pump manufacturer and the user.
2. Improper installation of the pump.
3. Improper pump selection.
4. Personnel too close to dangerous situation.

[unwanted chemical reaction, high pressure, installation inadequate, canned pump]

Lessons

The following recommendation were made and actions taken after the incident:

1. Removed canned pumps from nitric acid service. The pumps were replaced with conventional centrifugal pumps equipped with a Teflon seal as recommended by the acid supplier.
2. Study of the storage and handling of nitric acid. A HAZOP on the existing system which included nitric acid reviving, unloading and transfer procedures and equipment was complete.
3. Establishment of better nitric acid specification and mechanisms to deal with deviations. The expected physical characteristics of all incoming raw materials should be common knowledge for both the raw material personnel and the operating departments. Expected values of pertinent physical and/or chemical properties to be reviewed for all incoming raw materials, e.g. the expected temperature of nitric acid deliveries. Raw materials must not be unloaded unless they meet these criteria. In the case of a highly reactive material such as nitric acid, the temperature of the acid at the time of delivery to be noted on the delivery papers by the supplier, and be compared to the temperature of the acid on receipt by the plant. This could prevent the addition of contaminated acid undergoing a chemical reaction being charged to a storage tank. Deviations from expected conditions would trigger a "no go" to the unloading operation.
4. Establishment of a maintenance service reporting mechanism for pump manufacturers and other contract maintenance services. It was concluded that communications between the Maintenance Department and suppliers or contractors performing maintenance work on equipment needed to be improved. Whenever a piece of equipment is serviced by an outside contractor, they are relied to report their findings relative to the conditions of the equipment, probable cause of failure, recommendations, etc. Deviations from the previous materials of construction must not be made without agreement by the company. It was recommended that the Mechanical Department established procedures to assure that the required communications were operative.
5. Other applications in the plant with canned pumps in service. The canned pumps used in other services around the plant were studied for potential hazard.
6. Specific recommendations for canned pumps. It was recommended that the fuse boxes for all canned pumps be "locked out". It was to be assumed that these pumps are used to pump hazardous materials, and that any electrical or mechanical failure to be investigated by a qualified mechanic. Bearing wear and direction of rotation indicators available from the manufacturer on existing pumps in the plant were to be installed. Consultation with the manufacturer was underway regarding installation of these devices.

11269 June 1986

Source : CHEMISTRY AND INDUSTRY, 3, NOV, 1986.

Location : , UK

Injured : 4 Dead : 0

Abstract

A runaway reaction at a chemical plant led to the discharge into the atmosphere of some 600 gallons of concentrated acid. A jet of acid droplets from a ruptured bursting disc reached a height of 50-100 feet. Thirty local residents complained of eye and skin irritation after being showered by the falling acid. Four required hospital treatment.

The chemical plant makes mono-nitroxylene (used in dyestuffs manufacture) in the reactor that burst. Normally xylene in the tank is nitrated by the slow dropwise addition of mixture of concentrated sulphuric acid and concentrated nitric acid. 14 of 15 batches required had been made without any problems. An operator sought xylene from another part of the factory to complete the final batch. Unknown to the operator a 45 gallon drum labelled as xylene actually contained methanol.

When the acid mixture was added to the methanol a violent exothermic reaction followed. Plant operators struggled to control the reaction which caused a sharp increase in pressure within the tank. Eventually the tank ruptured via a bursting disc.

The company was prosecuted and sections 2 and 3 of the Health and Safety at Work Act

[gas / vapour release, bursting disc failure, reactors and reaction equipment, accidental mixing, reaction, labelling incorrect, injury]

Lessons

All chemical must be stored in correctly labelled containers.

1131924 May 1986

Source : ICHEME

Location : , BELGIUM

Injured : 1 Dead : 0

Abstract

A cloud of ethylene oxide (EO) gas was released from a hose connected to a reflux pump drain line. The pump had been under maintenance (pump seal changed) and was in stand-by ready for re-use. The vapour cloud was about 9 metres long by half a metre high. Two operators initially entered the region of the cloud with out respiratory protection. Then one of them donned respiratory protection and closed the drain valve, this stopping the leak. Some ethylene oxide splashed on his hands, trouser leg and shoes. He washed his hands changed his overalls but not his shoes. After the shift, at 06.00 hrs, the man went home. Subsequently, he felt irritation on his right foot and was treated by the works nurse, then sent to hospital. He had incurred second degree burns.

[gas / vapour release, spill, safety procedures inadequate]

Lessons

The main lessons learnt were:

1. The man did not adequately change his clothing after the incident and did not shower. This, without much doubt, resulted in his eventually receiving burns.
2. Both men initially entered the ethylene oxide vapour cloud without respiratory protection. There was an obvious potential hazard in this.
3. The sprinkler system was not used to damp down the ethylene oxide cloud. This was contrary to procedures and was based on an incorrect perception of the effect that the sprinklers would have on visibility of the source of the leak.
4. There was no detailed procedure for taking ethylene oxide in, and out, of service.
5. Operator training, in all these aspects, as not fully adequate.

Recommendations to address all these were put in hand.

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, D.C. 20594, VOL 6, NO. 9.

Location : , USA

Injured : 177 Dead : 0

Abstract

A rail transportation incident. A steam excursion train became de-railed after travelling over a section of line which had recently been repaired. The high number of injuries was partly attributed to the 'historic' rolling stock in use, some of which did not use 'tightlock' couplings between the carriages and were not fitted with safety glass or proper emergency exits. The absence of the 'tightlock' couplings increased the tendency of the carriages to jackknife.

The NTSB concluded that improper repairs, combined with track expansion in the heat of the day, caused a displacement of the rails at a track switch. The subsequent track inspection was inadequate (the relief track inspector had not performed that task for 9 years previously).

[rail transport, derailment - consequence, training inadequate, inspection inadequate, maintenance inadequate, injury]

Lessons

The NTSB issued a total of 21 recommendations for improvements, covering:

1. Improved inspection procedures.
 2. Better training in, and control of maintenance procedures.
 3. Application of the same safety standards to excursion trains. (as to other trains)
-

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, D.C. 20594, VOL 6, NO. 9.

Location : , USA

Injured : 0 Dead : 0

Abstract

A marine transportation incident. A deteriorated rubber expansion joint failed in the main seawater circulating system of a marine tanker. By the time the crew discovered the flooding, the bilge pump motor and the main seawater valves were submerged. Damage was estimated at \$12 million (1986).

The deterioration in the expansion joint had been noted in 1979 and 1982. Two new joints were ordered, the aft joint was replaced but the forward joint was repaired and re-installed. The repair concealed the extent of deterioration.

The single bilge alarm sensor failed to give early warning of the flooding of the engine room. If the chief engineer had closed the main seawater valves immediately, engine room flooding would have ceased.

[damage to equipment, maintenance procedure error, safety procedures inadequate, expansion joint failure]

Lessons

The NTSB recommended that:

1. Expansion joints in the main seawater circulating system should be replaced at least every 10 years.
 2. Multiple bilge high water level sensors to be fitted.
 3. Reach rods to be installed to enable remote manual operation of seawater valves.
 4. Emergency procedures should be written for engine room flooding.
-

Source : LLOYDS LIST, 1986, 6 MAY.

Location : Chernobyl, USSR

Injured : 30,00(Dead : 31+

Abstract

On 26 April 1986 a nuclear reactor at Unit 4 of a Power Station exploded.

The turbine manufacturers working on the commissioning of Unit 4, during late 1983 anticipated that the unit might offer emergency power for some seconds during shutdown as the turbines spin to a halt. A test of this system was proposed but postponed to allow the plant to be commissioned before the end of 1983. On 27 March 1984, Unit 4 commenced commercial operation.

In April 1986, Unit 4 was to be shut-down for maintenance. A series of tests was scheduled, including the delayed emergency-power test. It was still unknown whether the declining momentum of the turbines could generate enough power to run the water pumps for 40 seconds. The test had to be conducted by the generator's manufacturers. Their plan was agreed after a 15-minute discussion with the deputy chief engineer for Units 3 and 4. The safety inspector was not consulted and the nuclear deputy chief engineer was not present. Formal approval was given by the director without consultation with nuclear specialists.

At 13:00 the reactor was switched to half power and one of the two generators was switched off. The emergency core cooling system was disconnected to prevent it from tripping. Before the test started there was a request for power until 23:00. The test was restarted at 23:00. Autocontrol of the control rods was disconnected. The power reduced, which under standard procedure would require the test to be abandoned. There was disagreement on what to do next. Further control rods were removed and by 01:00 the power had stabilised below the recommended minimum power level.

Soon after 01:00 an additional cooling pump was added to the system, requiring more control rods to be withdrawn. The extra water passing through the reactor caused a drop in steam pressure, and to prevent shutdown due to low steam pressure the operators overrode the trip signals. At 01:22, just as the experiment was beginning, the computer printout showed a reactivity reserve margin of half the minimum. At 01:23 the emergency regulating valves to the turbo-generator were turned off and the steam was shut off from the turbine. The computer logged a rapid rise in reactor power. The shift controller pressed the emergency shutdown button to lower all the control rods into the core, but the rods failed to descend completely. An explosion occurred blasting off the 1000 tonne shield and leaving the reactor open to the atmosphere.

[testing, reactors and reaction equipment, radioactive release, testing inadequate, design or procedure error, fatality, injury]

Lessons

Root causes of the incident included:

1. Inadequate commissioning of plant.
2. System was not tolerant of faults.
3. Large core which required a complex control system.
4. Complex piping with inherent difficulties in providing emergency cooling to each channel.
5. Absence of engineered safeguard features to counteract operator error.
6. Test was inadequately planned.
7. Regulations were violated.
8. Inadequate safety training, unclear assignment of safety responsibilities.
9. Inadequate handling of emergency.
10. Engineers in charge of the test knew little about nuclear reactors.
11. Deviation from specified operating procedure and neglect of safety procedures.

1211512 April 1986

Source : FPA CASEBOOK OF FIRES, APRIL 1986.

Location : , WEST GERMANY

Injured : 0 Dead : 0

Abstract

A fire occurred which destroyed two textile warehouses and caused approximately £1.5 million (1986) damage. The fire is thought to have been caused by a cigarette or from spontaneous combustion inside a container of textiles and was not the result of arson.
[fire - consequence, damage to equipment]

Lessons

[None Reported]

10958April 1986

Source : HEALTH & SAFETY AT WORK, MAY 1987.

Location : , UK

Injured : 0 Dead : 1

Abstract

A canteen assistant was killed when crushed between a lorry trailer and a loading bay.

The accident occurred when the assistant left the canteen in torrential rain at the same time that a visiting lorry driver had been manoeuvring his lorry into the factory yard and reversing into the bay. The lorry driver felt a bump and left his vehicle without knowing what had happened.

[road transport, people, safety procedures inadequate, fatality]

Lessons

The following recommendations were made:

1. The best use of mirrors.
 2. Markings and other devices to improve visibility.
 3. The use of banksmen and the enforcement of the rule that no vehicle should ever move in reverse if the banksman cannot be seen by the driver.
 4. Insistence upon the last two rules would have prevented this tragedy.
-

3517 21 January 1986

Source : TORONTO GLOBE & MAIL, 1986, 19 MAR.

Location : Stoney Creek, CANADA

Injured : 0 Dead : 0

Abstract

A fire occurred in a hopper following decomposition of the insecticide azinphos-methyl. 1000 residents fled.

[human causes, maintenance inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

An incident occurred when a bulk cargo operator fell from the top of a ship-shore access ladder on to a deck of a vessel. The operator received injuries to his leg and ankle. The use of an access ladder is usual practice but questions relating to the safety of the access ladder are posed. The ladder had been 'lashed at the bottom', had a fixed hand-rail at 20.5 inches in height along the whole length, but did not have non-skid feet. There were no witnesses to this accident. It would appear that as the operator stepped onto the ladder he was hindered by the safety net that was provided by the ship to prevent entry into the water between the ship and the jetty. The cause of the accident was that the feet of the ladder slowly slid away due slack lashing.

The Master and owner of the ship were responsible for providing safe access between ship and shore. The specifications of ladders includes ladders to have non-skid shoes, to be constructed to specific British Standards and for all ladders to have a Manufacturer's Certificate which shows that it has undergone three stringent performance tests. The ladder involved did not meet these regulations.

[container ship, equipment misalignment, safety equipment failure, safety procedures inadequate, marine transport, fall, injury]

Lessons

1. Access ladders should conform to regulations. However the type of ladder should be reviewed.
 2. All ladders should be inspected and repaired where necessary.
 3. Access ladders should be securely lashed to prevent side-ways movement. However, alternative means of preventing side-ways movement should be investigated.
 4. Procedures to securing safe access and any checking protocols should be reviewed.
-

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

During unloading of liquid chlorine from a road tanker to a storage tank, an operator left the vent valve on the transfer line open, which allowed chlorine into the vent main. Flash vaporisation occurred and the pressure surge caused damage to the absorption, bleach and hydrogen chloride columns. Then, the failure of liquid loop seals resulted in a leak of chlorine into the chlorination building. The leak was isolated and water sprays were used to minimise the effects.
[storage tanks, seal failure, damage to equipment, operator error]

Lessons

1. Check-list with supervision during unloading.
 2. Installation of a system to control correct operation.
 3. Orifice plates into vent lines to prevent overpressurisation of absorption column should the vent be open.
 4. Design improvements are being evaluated.
-

127311986

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM, LESSONS LEARNED FROM ACCIDENTS NOTIFIED, EUR 13385 EN.

Location : ,

Injured : 1 **Dead :** 0

Abstract

An explosion occurred in the condenser of a reactor due to a runaway reaction. The incident occurred due to an accidental error in the order of introducing acids causing the formation of methyl nitrate, which in turn caused a runaway reaction. A worker was injured in the incident and damage to equipment occurred.

Chemicals involved: sulphuric acid, nitric acid.

[reactors and reaction equipment, operator error, injury]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

In unscrewing a nipple from a ball valve on a drain line the end cap of the valve unscrewed instead of the nipple. This end cap holds the ball in the valve so there was a large leak of LPG. Luckily there was another valve upstream which could be closed off.

[repair, blowout, incorrect equipment installed, maintenance procedure error]

Lessons

Maintenance workers should be warned that there are dangers in unscrewing any fitting on an operating plant. They must ensure that the joint which unscrews is the intended one and not another which is under pressure.

This design of ball valve is intrinsically unsafe in any service where the end cap might be unscrewed in error. It should not be used for such services as there are alternative designs available without this fault.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A valve on the inlet to a fluid catalytic cracking unit main fractionator was closed during start-up and then had to be opened to bring the unit into operation. The procedure was reversed during shutdown. The thermal shock of the change-over caused persistent flange leaks. The position was improved by better gasketing but it was only finally resolved by a change in operating procedures which avoided the need to use this valve.
[hydrocarbon, start-up, flange, blowout, fire - consequence, design inadequate, thermal expansion, joint leak]

Lessons

Procedures for start-up, shutdown or other changes in operation should be planned to minimise abrupt changes of temperature on equipment.

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A drain-wash line valve was left open allowing toluene to flow from the extraction column to a discharge system. Due to the failure of a detector the toluene was not diverted to the dump tank. As a result the toluene entered a public sewer. This sewer was closed for maintenance and, therefore, the toluene was diverted to a treatment plant. The pumps of this plant were out of action and the toluene was discharged into the river estuary.

[pollution, maintenance inadequate, testing inadequate, spill, processing]

Lessons

1. Removal of the direct connection column-effluent line.
 2. Increasing of test/maintenance frequency of the toluene detection system.
 3. On-site surveillance to identify other potential sources of effluent contamination.
-

Source : ENDS REPORT 151, AUGUST 1987.

Location : , UK

Injured : - **Dead :** 0

Abstract

Oleum fumes were released during loading of a tank. The incident occurred when the operator left his post allowing the material to overflow into a fume scrubber. The scrubber circulation tank eventually overflowed into a bund, causing dense fuming. Several members of the public were affected.
[operator error, gas / vapour release]

Lessons

[None Reported]

126801986

Source : ENDS REPORT 151, AUGUST 1987.

Location : Yorkshire, UK

Injured : - **Dead** : 0

Abstract

Sulphuric acid and nitric acid sprayed from a plant. The incident occurred due to the mislabelling of a storage tank resulting in a drum of methanol, instead of xylene, being fed to a nitration reactor. Several people were affected.

The company was fined £2,000 (1986).

[gas / vapour release, labelling incorrect, storage tanks, accidental mixing, material transfer, drums, reactors and reaction equipment]

Lessons

3471 17 December 1985

Source : THE EVENING SUN, 1985, 17 DEC.; DAILY TELEGRAPH, 1985, 18 DEC.; NEW YORK TIMES, 17 DEC, 1985, 18 DEC, 1985.

Location : Glenwood Springs; Colorado, USA

Injured : 13 **Dead :** 11

Abstract

A 1,000 gallon propane tank exploded at a gas company offices and repair garage, killing 12 people and injuring a further 13. The tank was on a flatbed truck that had just pulled in to a repair bay. It seems that someone was carrying out maintenance work on a leaking valve on the tank when the valve 'burst', releasing liquefied gas. It may be that the worker made an error in dismantling the valve.

Sources of ignition for the explosion were variously quoted as a welding torch, the pilot light on a gas water heater, and a hot air gun.

[LPG, fatality, maintenance procedure error, standards inadequate, operator error, injury]

Lessons

[None Reported]

Source : HOUSTON CHRONICLE, 1989, 24 OCT.

Location : Mont Belvieu; Texas, USA

Injured : 0 **Dead** : 2

Abstract

Contractors were excavating ground to two pipelines to make a break in. Natural gas liquid, propane, was released when the wrong pipe was opened and it ignited. Fatality. Evacuation.

[contractor error, excavation damage]

Lessons

The excavation was carried out and the correct pipeline was not identified. An Excavation Permit should include full details of which pipeline is to be worked upon.

3439 05 November 1985

Source : 100 LARGEST LOSSES, 9TH EDITION, MARSH & MCLENNAN PROTECTION CONSULTANTS, 1986; HOUSTON POST, 1985, 6 NOV.; HOUSTON CHRONICLE, 1985, 6 NOV.

Location : Mount Belvieu; Texas, USA

Injured : 0 **Dead :** 2

Abstract

A large gas release and ignition occurred at an LPG underground storage facility on a petroleum plant. The ground was excavated above pipelines to carry out a modification. Two pipelines were exposed and pipe cutters used on one by 2 contractors, there was a sudden release of ethane and propane which ignited there were 10 explosions and extensive fires. Fatality.

The blast was caused when an ethane/propane pipeline ruptured during routine maintenance. Explosion and fire.

[excavation damage, gas / vapour release, fire - consequence, contractor error]

Lessons

[None Reported]

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, D.C. 20594, VOL 5, NO. 2.

Location : , USA

Injured : 2 Dead : 1

Abstract

A marine transportation incident. An explosion occurred on a marine tanker just after it had departed from the port. The force of the blast knocked the pilot and two crew members into the sea - one of the crew was not found and presumed dead. The vessel broke in two a few days later and the stern section sank. It was concluded that hydrogen gas formed after caustic soda leaked into the void space, where it reacted with zinc in the paint and galvanised piping. The source of ignition was not determined.

The ship's master had been alerted to the possibility of a leak 9 days before the incident, but had decided to delay inspection of the tank until it had been emptied and cleaned.

An examination showed that the hole between the cargo tank and the void space probably resulted from a flaw in the stainless steel clad bulkhead, allowing the caustic soda to corrode the underlying steel.

[marine transportation, fatality, sinking, corrosion, lining failure, inspection inadequate]

Lessons

The NTSB issued a number of recommendations, including procedures for 'sounding' or inspection when measurements indicate leaking cargo.

3431 26 October 1985

Source : NEW YORK TIMES, 1985, 29 OCT.

Location : Linden; New Jersey, USA

Injured : 0 **Dead** : 0

Abstract

Release of hydrogen sulphide during cleaning. Operator error, instruction and procedures not followed.

[Leak]

Lessons

[None Reported]

3416 10 October 1985

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An explosion occurred involving a pump and crude oil at a production pump station. This was caused by operator error.

Lessons

[None Reported]

3404 23 September 1985

Source : NEW YORK TIMES, 1985, 24 SEP.

Location : Staten Island, USA

Injured : 0 Dead : 0

Abstract

Transportation. A 12 inch gasoline pipeline ruptured by a used by excavation contractors, caused extensive spillage in the streets. No ignition occurred. Evacuation.

[damage by backhoe, excavation damage, contractor error]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

At 13:30 on 11 September a muffled bang was heard by personnel in the acrylonitrile plant offices. Later it was discovered that an explosion had taken place in the bottom heads of a reactor. It was found that an operator had mistakenly zero checked the air meter to the reactors when it had been intended to check the propylene meter. The air control valve had opened up in response to a falling signal causing too much air to be fed to the reactors. The ammonia feed which was on ratio control to the air flow fell as the indicated air flow dropped to zero. The increased air flow together with the loss of the diluting effect of the ammonia moved the composition into the flammable region. The source of ignition was probably provided by a hot spot in some of the reactor tubes. [acrylonitrile, operator error, identification inadequate, explosion, reactors and reaction equipment]

Lessons

Recommendations made following the incident included:

1. Clearly labelling all instruments on the acrylonitrile plant.
 2. The installation of a low flow trip on the ammonia supply to each reactor pair.
-

Source : NATIONAL TRANSPORT SAFETY BOARD, AUGUST 4, 1985.**Location** : Oklahoma, USA**Injured** : 49 **Dead** : 0**Abstract**

A road transportation incident. A tractor-semitrailer vehicle carrying ten 2,000-lb bombs for the US Air Force was in collision with a private car. The incident occurred at about 03:30 in the morning and weather conditions were good. The driver of the car had driven past her intended exit point and had slowed down with the intention of doubling back. The first of two trucks carrying bombs passed her but the second hit her car and spun it round, rupturing the fuel tank. Immediately after the collision a fire erupted and engulfed the rear and right side of the car and the front of the tractor. The car driver and passenger were able to escape (with help from the truckdriver) before the first explosion occurred. Police and fire crews were quickly on the scene, and closed the road, and a nearby railway line. Further explosions followed during the next few hours, and a nearby town was evacuated.

The explosions caused substantial damage to buildings in the area - total property damage was estimated at \$5 million (1985). Over 3,000 tonnes of material were needed to fill the crater left by the explosions. Forty nine people reported for medical attention - most of these were suffering from the effects of breathing smoke.

[road vehicle, injury, damage to equipment, driver error, safety procedures inadequate, explosive, fire - consequence, evacuation, injury]

Lessons

The NTSB found many deficiencies in the circumstances surrounding this incident:

1. The bombs did not have thermal protection to reduce the danger from fire.
2. The Department of Defence did not have an adequate munitions transportation safety programme.
3. The route used was not the most direct (thus leading to increased public exposure).
4. The truckdrivers involved had inadequate training and experience.
5. Minimum evacuation distances in the emergency response guidebook were inadequate
6. Safety audits of the transport company were inadequate

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, D.C. 20594, VOL 6, NO. 4.

Location : ,

Injured : - Dead : -

Abstract

A rail transportation incident. An eastbound 3-car passenger train was struck by another train whilst it was stalled on a curve 900 feet from a station. It was determined that the probable cause of the accident was due to the failure of the operator of (the moving) train to comply with the signal aspects displayed and to monitor properly the track ahead and react in time to safely stop the train.

Contributing factors were:

1. Vegetation blocking visibility.
2. Broken 'trip-arms' on the signals which should have operated the automatic train stop protection system.

[collision, damage to equipment, operator error, safety procedures inadequate, maintenance inadequate]

Lessons

The NTSB called for:

1. Modified operating rules to improve safety when the automatic train stop or control systems were not functioning.
 2. Improved internal safety oversight and system maintenance.
 3. Speed restriction signs in areas of limited sight distance.
 4. Improved training.
-

Source : LOSS PREVENTION BULLETIN, 078, 11-13.

Location : ,

Injured : 1 Dead : 2

Abstract

An explosion occurred in an ammonia plant resulting in two fatalities and serious injuries to another worker. Part of the gas purification plant was damaged. The incident occurred during a water feed pump change over. Pump A with turbine was to be put into operation and pump B taken out. Three operators performed the change. However, the suction valve for the pump which was put into operation (pump A) was not opened and the plant subsequently shut down due to the failure of the water supply when pump B was stopped (low level trip on the absorption tower). As this fault was not discovered, the shift supervisor and the operators decided to start the plant again with water pump A. The water pump A was started, and the block valve (6mm) on the line to the absorption tower on the discharge side of the pump was opened after 10 seconds in accordance to the written instructions.

The operator in the control room noticed that the water flow was varying between 400 and 1700 m³/h (normal 2600 m³/h) and reported this via radio to the operators in the pump hall.

The operators then discovered that the suction valve was closed and reported this. They tried to open the valve but could not due to the high differential pressure against the gate valve. A small 50 mm bypass valve was already open, and this gave the reported flow on the flow indicator upstream from the valves.

Due to the suction valve being closed, the pump started cavitating/boiling and the axial thrust force balancing system lost its water flow. Consequently, the thrust collar of the bearing came in contact with the bearing cover which then turned red hot.

The temperature was thought to have been at least 750 degrees C.

The pump was stopped by the operator and normally the interlock system should have closed the block valve to the absorption tower.

However, the block valve stuck in a 40% open position and the check valve which was in series did not operate because the differential pressure was too small. The backflow rate had been limited by the capacity of the 50 mm bypass on the suction valve of the pump and later by the additional leakage to the pump hall.

This resulted in continuous flow of water from the absorption tower, followed by hydrogen gas which eventually entered the water main and the pump hall via the leaking flange. The operators, realising the situation, tried to depressurise the absorption tower by manual blowoff valves situated on the gangway on the pump hall roof. Whilst doing so, the pumphall exploded under them.

The following causes were found:

1. The check valve needed a major reverse flow of the water stream to provide the necessary force to close the valve.
2. The water pump suction side was designed for only 10 bar pressure and not for a discharge pressure of 40 bar.
3. The pump system was placed inside a building for frost protection, this made the confinement of hydrogen leakages possible.

[normal operations, design inadequate, fatality, injury]

Lessons

[None Reported]

Source : ICHEME

Location : , BELGIUM

Injured : 0 Dead : 0

Abstract

An explosion occurred in the primary bins of two reactor lines at an adjacent dust collector and in the interconnecting piping. All eight bins lost one or several of their rupture panels, parts of the purge exhaust lines from the bins were blown and a fire persisted at the dust collector.

The fire in the reactor lines was rapidly extinguished by a portable powder extinguisher at the bins and dust collector cooled by water spray by the fire brigade.

The transfers out of the bins were stopped immediately.

The cause of the incident was due to the stopping of the purge blowers of the primary bins for maintenance work at the dust collector.

Insufficiently purged polyethylene was still present, leading to explosive mixtures in some parts of the silo systems. Damage to equipment.

[reactors and reaction equipment, material transfer, maintenance procedure error]

Lessons

[None Reported]

Source : GUARDIAN 13/6/85, TIMES 13/6/85, LLOYDS LIST 6/6/85 AND OTHER NEWSPAPER ARTICLES

Location : Bradford, UK

Injured : 200 Dead : 56

Abstract

A 4000 capacity, football stadium stand was destroyed by fire. The fire is thought to have started when a lit cigarette, or match was dropped through a hole in the wooden floor of the stand, onto rubbish that had accumulated below. The seventy year old stand had wooden and plastic seats and an asphalt roof. When the stand caught fire, the roof created a grill-like effect, radiating intense heat downwards. The whole stand was engulfed in flames within five minutes of the first signs of fire, with molten asphalt from the roof dripping onto spectators. The number of casualties was exacerbated by locked doors and turnstiles and the absence of trained stewards, evacuation procedures and fire fighting equipment.

[fire - consequence, safety procedures inadequate, fatality, people, injury]

Lessons

The interim report of the inquiry into the fire made the following recommendations to improve sports ground safety:

1. All exit gates at grounds should be manned at all times while the ground is in use by the public, and in the event of emergency should be capable of being opened immediately from the inside.
 2. No new stands should be built from combustible materials.
 3. There should be a smoking ban in existing combustible stands.
 4. Fire authorities should have powers to restrict the use of stadium stands which have inadequate fire precautions.
 5. Evacuation procedures should be part of police training and form part of the briefing by police officers before a match.
 6. Stewards at all sports grounds should be trained in fire fighting and given written instructions about emergency action.
 7. Where practical, roads within quarter of a mile of grounds should be kept clear of parked vehicles to ensure fire engine access.
 8. A local registration system should be established to ensure a complete record of sports grounds is kept up to date.
 9. Clubs to review arrangements for entry and the organization of their turnstiles.
-

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, D.C. 20594, VOL 5, NO. 2.

Location : , USA

Injured : 1 Dead : 0

Abstract

Two 34 foot long spans of a bridge collapsed into the river, one vehicle entered the water as a result. The sole occupant of the vehicle swam to safety with minor injuries. (The average daily traffic volume on the bridge was 20,000 vehicles, but the collapse occurred at a time of low traffic volume.) Underwater examination revealed that exposed steel H-piles were severely corroded. The bridge had been inspected earlier in the month of the accident, but the underwater elements had not been inspected since 1969.

Corrosion of the H-piles had probably been accelerated due to exposure to polluted, brackish water under tidal influence.

[road transportation, road transport, damage to equipment, inspection inadequate, collapse, injury]

Lessons

The NTSB called for a number of improvements to the state's bridge inspection programme:

1. Revision of bridge inspection report forms to highlight dates of underwater inspection.
 2. Measurement of bridge span misalignment.
 3. Establishment of criteria for underwater elements of bridges to consider:-
 - complexity of structure
 - safe load capacity
 - marine environment
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 2

Abstract

A marine transportation incident. A marine tanker carrying ballast suffered an explosion whilst tanks were being cleaned. The vessel had been previously transporting gasoline. The explosion created two holes in the sides of the vessel, the larger of which was approximately 250ft long. This resulted in the vessel taking on water and developing a list.

The explosion also created a fire lasting two hours until brought under control by crew. When subsequent efforts to correct the list failed, the crew were evacuated.

The Coast Guard accounted for 27 of the 29 crew, the two missing crew were known to be working in the area of the explosion at the time. An air search failed to locate them.

Although the vessel was fitted with a gas-freeing system and fixed and portable tank cleaning equipment, Coast Guard officials believed that the cleaning procedure caused fuel residues to ignite.

[cleaning, evacuation, cleaning procedure incorrect, fatality]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

Whilst removing sections of cut roof plate, a demolition worker's glove caught a rough edge causing him to lose balance and fall to the tank floor. He was not wearing any form of safety harness and life line whilst working on the tank roof.
[personal protective equipment, safety procedures inadequate]

Lessons

The report stated the following recommendations:

1. All work on tank roofs to cease in periods of high winds or heavy rain.
 2. Work to continue on tank wall demolition only when partly cut sections are properly supported.
 3. Safety harnesses to be used whilst working on tank roofs.
-

Source : SEDGWICK LOSS CONTROL NEWSLETTER

Location : Offshore; Louisiana, USA

Injured : 0 **Dead :** 0

Abstract

High pressure water jet sledge used by contractors to trench a 12 inch pipeline into the seabed ruptured the line.
[contractor error]

Lessons

[None Reported]

3198 07 January 1985

Source : THE GUARDIAN, 1985, 31 JAN.; ICHEME

Location : Mount Roskill; Auckland, NEW ZEALAND

Injured : 1 Dead : 0

Abstract

A service station assistant was seriously burnt when compressed natural gas (CNG) was released from a bursting disc while filling a car. He rapidly turned the gas off at the valve near the filling nozzle. As he did so it ignited. After investigation it was found that a spring-loaded pressure control valve had been incorrectly set to deliver gas above the maximum allowable pressure and it is thought that this caused the burst disc to blow.

[fire - consequence, installation inadequate, burns]

Lessons

[None Reported]

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A small explosion with subsequent fire occurred during the addition of a powdered pharmaceutical product through a stainless steel charge chute into a chemical reactor containing solvent acetone at 40 degrees C. The damage was limited to fire damage to a nearby control panel and electric cable insulation. As no operators were in the vicinity of the charge chute at the time, no one was injured. The charging operator had just started operating the control valve on the acetone addition line 3 m away when the explosion occurred.

Investigations showed that the procedure was not a normal one in that a dry powder was added to the flammable solvent instead of the usual wet cake. The powder was a finished product that had not passed quality control purity tests and had to be recrystallised. No nitrogen inerting was used and as some acetone vapours could have been emitted from the charging chute, combustion was possible. The most likely source of ignition could have been an electrostatic discharge resulting either from splash filling of the acetone or from the chute charging of the finely divided pharmaceutical powder.

[reactors and reaction equipment, fire - consequence, charging reactor, safety procedures inadequate]

Lessons

To do a safety review on all non-standard operations before re-start.

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

The reactor was used to oxidise a pyridine compound with hydrogen peroxide using a maleic anhydride catalyst to form a pyridine-n-oxide. The reaction was recognised to be exothermic, therefore, hydrogen peroxide was added at controlled rates. Safety features included, circulation of the reactor content through 2 heat exchangers, a 200 cm pressure relief line to the atmosphere with a 0.7 bar bursting disc, a water quench tank situated 3 m above the reactor, which should dump automatically its content into the reactor should a sudden rise of temperature occur.

The peroxide addition pump should not operate if the quench tank was not full, the circulation pump was not operating or the reactor vent was not open to the atmosphere.

Probably due to an error of the operator, an accelerated rate of hydrogen peroxide (estimated to be about one order of magnitude higher than the normal addition rate) through the manual by-pass led to a sudden temperature increase. Although the quench tank was automatically activated, an explosion occurred a short time later and the entire reactor content was emitted either to the process area through the reactor manway, which was covered with an aluminium foil disk which should burst at 0.14 bar, or to the atmosphere through the pressure relief line.

[reactors and reaction equipment, operator error, high temperature]

Lessons

1. The closure of the reactor manlid during oxidation.
 2. The removal of the by-pass on the peroxide transfer line.
 3. The provision of an emergency dump tank on the reactor 200 cm vent line.
-

110841985

Source : LLOYDS LIST, 25 JUN, 1985, 1 JUL, 1985, GUARDIAN, 1 JUL 1985.

Location : Los Angeles, USA

Injured : 0 **Dead** : 50

Abstract

An outbreak of the bacterial disease listeriosis was linked to contaminated cheese produced at a factory where raw milk had been mixed with pasteurised milk to increase production. Fatalities were concentrated among newborn or still born infants and the elderly and infirm.

[fatality, people, processing, safety procedures inadequate, contamination, accidental mixing, toxic chemical]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A road transportation incident. A road tanker was used intermittently to transport residual oil at a temperature above 100 degrees C within a refinery. The tanker was supposed to be inspected to be sure it was dry before using it for this service. On one occasion the presence of water was not noticed and the tanker foamed over when loading was started. An independent check was instituted after this incident.

[hydrocarbon, boilover, safety procedures inadequate, operator error]

Lessons

It is unwise to leave an occasional operation like this, which has dangers that the tanker driver will never otherwise encounter, solely in his care. An independent check by an operator that the tanker is dry is required.

To eliminate the problem completely a pipeline was later installed to transfer this hot residue.

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

After a reaction, in which raney nickel was used as a catalyst, had been completed, the reactor was to be flushed out by ethanol decanted from an 8 m³ capacity vessel. When the reactor was full, the manway was closed and heating started. After a certain period of time, the control room operator discovered that the temperature was 87 degrees C, well above the pre-set level of 70 degrees C. He shut off the heating but shortly afterwards the fire alarm in the area and the sprinkler system were activated. The flash fire was extinguished by the sprinklers system.

Post-accident investigation showed that the temperature control loop failed (controller output failed to update control valve position) and that the reactor manhole clamps were not fully tightened.

In addition, an examination of the remaining content in the ethanol vessel showed that the reactor was slightly overfilled. Consequently, ethanol vapours must have been emitted through the loose reactor manhole. The most probable ignition source could have been pyrophoric nickel material forced out of the reactor by the boiling ethanol at the partially closed manhole (the investigation revealed that all electric equipment in the area was functioning correctly).

[reactors and reaction equipment, fire - consequence, operator error, runaway reaction]

Lessons

1. Provide that the post-campaign flush-out batch sheet gives a warning of potential overfilling of the reactor;
 2. Introduce proper manhole bolting practices;
 3. Ensure that control room attendants carefully review all non-standard operations with local operators;
 4. Update preventive maintenance plans to ensure that steam control valves and associated control loops are regularly checked.
-

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

The chloride activated catalyst in a naphtha reforming unit has to be regarded by burning off coke. Shortly after coming back on stream after a regeneration, a leak development in the reactor effluent air cooler. During regeneration a bicarbonate solution was injected to the inlet of this cooler to prevent hydrochloric acid corrosion. It was found that the control for maintaining the composition of this solution for the whole regeneration period were inadequate. This was corrected and the injection point was modified to improve distribution of the solution.

[hydrochloric acid, start-up, fin fan cooler, blowout, cleaning inadequate, inspection inadequate]

Lessons

[None Reported]

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

During the addition of phthalic anhydride to a varnish kettle which contained a mixture of soya bean oil, glycerol and caustic at 200 degrees C, an explosion occurred at the charging hatch. The operator was blown back by the force and broke his arm as he fell to the ground. Two other operators standing nearby were not injured. The charging chute was also propelled upwards and damaged the kettle agitator motor. The content of the vessel was unaffected. The bursting disc in the kettle pressure relief line did not rupture. The steel charging chute was not bonded to the reactor because of the presence of a non-conducting gasket in between, hence the most likely cause of the explosion is the ignition of phthalic anhydride dust by a static discharge from the unbonded chute.

Since this accident, the company was required to check that all equipment used to transfer phthalic anhydride powder is bonded to earth and to amend the operating procedures and ensure that the dangers associated with phthalic anhydride are highlighted.

[safety procedures inadequate, charging reactor]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

Approximately 2 tonnes of propylene oxide spilled during maintenance on a section of a propylene oxide road tanker off-loading line.

The cause was due to not taking into account that propylene oxide was present in the line, which had previously been cleared.

[maintenance inadequate, draining of line insufficient]

Lessons

The report stated the following recommendation:

Compulsory tagging of valve isolations in the ethylene oxide/propylene oxide storage and off-loading areas when isolating for maintenance work to be carried out.

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

Work was being carried out by a licensed asbestos contractor. The work area was segregated by the contractor with a 'roped off' area in accordance with the contractor's accepted method of work. The rope was a 1/2 inch brown manila rope with signs stating "Keep Out Asbestos removal in progress." The notice but not the rope were removed when work was not in progress, such as overnight. On the third night an employee on the plant cycled into the rope and was brought down with his bicycle. Some time later a fractured skull was diagnosed and it was only after an emergency operation, intensive care and a period of convalescence, that the employee recovered.

[safety procedures inadequate, contractor error, maintenance]

Lessons

1. All works should review their standing instructions or procedures and methods of work, to make provisions to ensure that barriers and particularly temporary barriers intended to segregate areas of work for protection, will not in themselves give rise to a hazard.
 2. All works should ensure that instructions to contractors are clear and that methods of work, consistent with site or factory arrangements, are part of the contract agreement.
-

Source : ICHEME

Location : , BELGIUM

Injured : 0 Dead : 0

Abstract

The front crosshead pin through bolt of the second stage of an ethylene hypercompressor failed due to fatigue. Both front feed cylinders were fractured causing an ethylene leak. The system was shutdown and the ethylene leak diverted to the reactor enclosure without ignition. The cause of the failure was attributed to a number of maintenance items.

[material of construction failure, gas / vapour release, reactors and reaction equipment, maintenance inadequate, near miss]

Lessons

[None Reported]

Source : THE TIMES, 1984, 21 NOV.; THE TIMES, 1985, 23 JAN.; GUARDIAN, 1985, 23 JAN.; HAZARDOUS CARGO BULLETIN, 1985, FEB.

Location : Slaithwaite; Yorkshire, UK

Injured : 16 **Dead** : 0

Abstract

A road transportation incident. A road tanker of ferric chloride incorrectly labelled as sodium hypochlorite was unloaded into a tank of sodium hypochlorite causing the release of chlorine.

[offloading, spill, unloading, labelling incorrect]

Lessons

[None Reported]

3143 19 November 1984

Source : MARSHALL V.C, MAJOR CHEMICAL HAZARDS;100 LARGEST LOSSES, 9TH EDITION, MARSH & MCLENNAN PROTECTION CONSULTANTS, 1986;

Location : San Juan Ixhuatepec, MEXICO

Injured : 7231 **Dead :** 500

Abstract

Some 11,000 m³ of liquefied petroleum gas (LPG) was stored in six 1600 m³ spheres and 48 horizontal cylindrical bullets, all in close proximity. The legs of the spheres were not fireproofed. It is believed that no fixed water sprays or deluge systems were fitted to the tanks. A leak of LPG from an unknown source formed a vapour cloud which was ignited by a plant flare. The storage area was banded into 13 separate areas by walls about 1 m high. A fierce fire developed, engulfing the spheres which went up one after the other in a series of BLEVEs (Boiling Liquid Expanding Vapour Explosion). Nine explosions were recorded. This series of LPG explosions at the distribution centre resulted in 542 fatalities and over 7000 people being injured. Some 200,000 people were evacuated. The fireballs were up to 300 m in diameter and lasted as long as 20 seconds. Rain consisting of liquid droplets of cooled LPG fell over the housing area covering people and property. It was set alight by the heat from the fireballs. Since the construction of the plant some 100,000 people had settled in crowded housing on the valley floor and slopes. This had spread to within 130 m of the plant. The local housing was mainly single storey and built of brick between concrete pillars. At least five people lived in each home. LPG was used for heating and cooking and each household had its own small bottles. Some 2000 houses at 300 m were destroyed and 1800 were badly damaged. Windows were broken at 600 m and missiles were thrown a considerable distance. One cylinder was thrown 1200 m. The emergency plan functioned well in the circumstances. Fatality.

[fire - consequence, storage tanks, damage to equipment, fire - consequence, safety procedures inadequate, injury]

Lessons

1. The high death toll occurred because the housing was too near to the plant. At the time the plant was constructed the area was underdeveloped, but over the years the built-up area had gradually crept up to the site.
 2. The total destruction of the facility occurred because there was a failure of the overall system of protection, which includes layout, emergency isolation and water spray.
 3. One feature which might have averted the disaster is more effective gas detection and emergency isolation. The plant had no gas detector system and, probably as a consequence, emergency isolation was too late.
-

9983 06 November 1984

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

During the start-up/commissioning of a polymer plant, the drains became blocked. During maintenance operations steam was applied to free the polymer. Operator error, in believing that the drain was full of cold water, resulted in a scalding injury when he stepped into the water.

[injury]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

An operator stumbled into a drain settling pit, containing hot acidic liquor (acetic acid) and sustained scald burns to his feet and lower legs.

He required hospital treatment. The accident resulted from operational safety standards not being maintained. The main safety shortcomings included:

1. Pit not covered or barriered off.
2. Tripping hazards nearby.
3. Pit flooded over its rim onto the adjacent sloping area.
4. Poor visibility (heavy rain, steam leaks and low lighting intensity).
5. High level of process activity at time of incident.

[fall, safety procedures inadequate, injury]

Lessons

The recommendations centred around rectifying what was a potentially high hazardous working environment:

1. Erect handrails round the pit.
 2. Proper cleaning of the pit, to prevent blockages which, in turn, prevent adequate liquor run off to drain.
 3. Improved lighting.
 4. Re-design of the pit to reduce frequency of blockages.
 5. Routine drain capacity checks.
 6. Gratings and drain covers, not to be lifted and then unattended, unless guarded by barriers.
 7. Better use of the Hazard Log Book. This was in existence but there had been only one entry made, in 1984, up to the date of the incident, despite the obvious range of hazards present.
 8. A stringent safety and to be carried out
 9. The operator was wearing a PVC suit which, without much doubt, saved him from further injury.
-

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

An operator lost his finger when operating a masson cutter being used to grind fused resin. When starting it up he found material coming out of a port which should have had a cover. He pressed the stop button and climbed onto the machine to push a polythene bag into the hole and in doing so his finger was cut off by the still rotating cutter.

[operator error, solids processing]

Lessons

The following recommendations were made.

1. Masson Cutter inspection port cover plate to be fitted.
 2. All machinery on plant to be inspected to ensure that access to running moving parts is impossible.
 3. All operators to be informed that, upon any failure or malfunction of plant equipment, the correct procedure is to isolate the power to that piece of equipment and to report to the shift supervisor.
 4. All operators to be reminded that plant machinery can continue to run-on mechanically, after disconnection of electrical drive.
-

Source : ICHEME

Location : , BELGIUM

Injured : 1 Dead : 0

Abstract

As a result of lack of knowledge of the precise construction of a valve, a pressure release occurred during maintenance work on the valve. The valve stem and handwheel were violently ejected causing injury to one worker. The jet of escaping nitrogen hampered rescue operations.

[safety procedures inadequate, training inadequate, explosion / pressure release, injury]

Lessons

The following recommendations were included in the report:

1. The potential hazards of working on equipment under pressure must be re-emphasised. (safety procedures inadequate).
 2. Knowledge of the equipment is of utmost importance. No one had ever seen the valve stripped down.
 3. The valve had been installed in the wrong direction.
 4. The shaft key was damaged by excessive force in an attempt to open the valve. The shear pin did not operate correctly.
 5. The training of the fire squad to rescue people from restricted areas should be reinforced. (training inadequate)
-

3035 21 June 1984

Source : THE GUARDIAN, 1984, 22 JUN.

Location : Sullom Voe, SCOTLAND

Injured : 0 Dead : 3

Abstract

A concrete, gravity based offshore production platform was shutdown for annual maintenance work.

Ten men were working in on of the 170 m long legs of the platform used for utility services. It housed pipework and pumps. Three of the men were attempting to cut into a storage water pipe 180 ft below sea level. The job involved hot work and the lining of the pipe they were cutting into caught fire and quickly produced large quantities of toxic fumes, including hydrogen cyanide.

Seven men working at higher levels in the leg either escaped unaided or were rescued. However the three men working at the lower level died.

A secondary fire started but was extinguished.

More than 100 workers were evacuated to nearby support and accommodation units.

[fatality, safety procedures inadequate, entry into confined space, pipework, fire - consequence, gas / vapour release]

Lessons

[None Reported]

3005 23 May 1984

Source : NEW SCIENTIST, 1985, 23 MAY; LLOYDS LIST, 1985, 25 MAY.; FIRE PREVENTION NO.176, JAN/FEB 1985, 38-40.; THE TIMES, FEB 22, 1989.; THE DAILY TELEGRAPH, FEB 10, 1989.

Location : Abbeystead, Lancashire, UK

Injured : 28 **Dead** : 16

Abstract

An explosion occurred at pumping station killing 16 people and injuring 28. The incident occurred during a demonstration on how the pumping station would prevent flooding in nearby homes. Investigations later discovered a reservoir of methane gas, some of which seeped into eight miles of pipeline, connecting two of the nearby rivers.

The most likely cause for the ignititon of the gas cloud was by a lighted cigarette.

[vapour cloud explosion, fatality, leak, injury]

Lessons

[None Reported]

2879 06 January 1984

Source : INSTITUTE OF INSURERS

Location : Amsterdam, NETHERLANDS

Injured : 0 **Dead** : 0

Abstract

Fire damage to cold storage building in a tank terminal and storage facility. Cause, welding by contractors.

[fire - consequence, contractor error]

Lessons

[None Reported]

9164 January 1984

Source : LLOYDS LIST, 1981, APR, 23.

Location : La Hague, FRANCE

Injured : 20 Dead : 0

Abstract

A fire occurred in a nuclear waste silo. 20 people were contaminated due to the slow reaction to evacuate buildings down wind.
[fire - consequence, evacuation, silo/hopper, contamination, safety procedures inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A pipefitter was killed when he was hit by hydrofluoric acid. The incident occurred whilst a fitter was standing on the floor in front of the vaporiser tube plate whilst another fitter was standing on scaffolding removing plugs from tubes on a HF alkylation unit. Six plugs had already been removed when the pipefitter removed the seventh he noticed vapour coming from the tube/plug and informed the other fitter to beware and stepped aside. At that moment the plug shot out and hydrofluoric acid hit the victim.

[fatality, maintenance, safety procedures inadequate]

Lessons

The report stated the following conclusions:

A number of tubes of the conditioned bundle had been plugged off as a protective measure since they were known to be frequently subjected to corrosion.

It is thought that there had not been a tight seal between the plug and the tube in question. Consequently acid containing process fluid gradually accumulated in the tube while the exchanger was in operation.

During the neutralisation step with ammonia the plugged off tubes which were filled with HF and light hydrocarbons could have been depressured slowly and become sealed by a solid layer of NH_4F , so that no signs of escaping process fluids were seen when the level was removed.

During the unplugging this seal was broken, resulting in the fatal accident.

123011984

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An incident occurred during maintenance on a heat exchanger. Two fitters were sprayed with oil whilst removing three tubes from a vertical fixed tube sheet reboiler for inspection. Fortunately, neither of the fitters was injured.

An investigation discovered that the shell side of the exchanger had been left under nitrogen pressure.

[near miss, safety procedures inadequate]

Lessons

The following recommendations were stated in the report:

The condition of equipment must be checked before a clearance certificate is issued.

A check on the exchanger would have revealed that it was still under pressure.

Fitters carrying out the work must follow all safety precautions specified on a safety certificate.

This is particularly important in plants handling highly toxic material such as phenol.

Source : HAZARDOUS CARGO BULLETIN, APRIL 1986.

Location : , UK

Injured : 0 **Dead :** 0

Abstract

A road transportation incident. A policeman was affected by fumes from a road tanker carrying waste acid tar for disposal. The tanker had been left standing after loading for an abnormally long period of time. The policeman had happened to notice fumes coming from the top of the vehicle just after it left the chemical works, and had escorted it to the nearby work's vehicle fleet repair garage. At the garage it continued to emit acid and toxic sulphur dioxide fumes. By night-time, under damp, still weather conditions, the fumes formed a heavy misty cloud, which filled the garage and threatened some old people's flats nearby. Traffic had to be halted and the flats evacuated as a precaution.

The investigation found that although the tanker was designed to be pressurised and had a relief valve fitted, the source of the fumes was leaking manhole joints. The joints had been poorly made after the tanker was loaded.

[maintenance inadequate, evacuation, people]

Lessons

The investigation revealed a lack of knowledge by the company about the properties of waste tar and its ability to evolve gaseous products on standing or subsequent transportations.

2796 07 November 1983

Source : ICHEME

Location : , ISRAEL

Injured : 0 Dead : 0

Abstract

Fire on a hopper at a mixed fertiliser plant caused by operator error.

[fire - consequence]

Lessons

[None Reported]

2791 02 November 1983

Source : ICHEME

Location : , KUWAIT

Injured : 0 Dead : 0

Abstract

Explosion at a refinery utilities plant involving methane. Source of ignition was boiler.
[operator error, refining]

Lessons

[None Reported]

1162825 October 1983

Source : THE GUARDIAN, 18 SEP, 1984, THE TIMES, 26 OCT, 1983.

Location : Aberdeen, UK

Injured : 16 Dead : 5

Abstract

A massive gas explosion ripped out the reception area of an hotel. Workers had been digging to locate a gas leak in a pipeline near the hotel. A brick dropped onto an 'impulse pipe' and fractured it. This seems to have allowed medium pressure gas to enter the low pressure gas meters at the hotel, thus bursting them and allowing gas to escape into the hotel boilerhouse, causing the explosion.

[methane, maintenance, repair, fatality, maintenance procedure error, safety procedures inadequate]

Lessons

The leader of the enquiry said that 'the workers should have been supervised, and the explosion would probably not have happened if meter governors had been fitted'. He also criticised lack of liaison between the distribution and service department of the gas supply company.

Source : LOSS PREVENTION BULLETIN, 122, 11-17.

Location : ,

Injured : 0 Dead : 0

Abstract

Collapse of the top sections of two carbon dioxide regenerator towers on a ammonia plant occurred. The collapse was due to the formation of an internal vacuum.

One contributory factor leading to the vacuum formation in the towers was due to operator error to open a valve to allow air into the system because the operator was worried about allowing a flammable gas/air mixture to occur. A quantified hazard analysis was therefore carried out to assess the risk of explosion if air was allowed into the towers.

[separation equipment]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An 8000-litre batch reactor had been charged with a raw material and solvent: then a fault on the refrigeration plant caused an interruption of the process for several days. The allegedly non-reactive chemicals remained in the reactor without supervision and with the agitator running. This had been the practice several times in the case of delays.

After 6 days, smoke was seen coming from the reactor. The temperature had risen from 60 degrees C to 160 degrees C and was still rising. Although full cooling was now applied, tar-like material was thrown out of the manhole and after a very short time the reactor exploded, although the 450mm manhole was fully open.

[storage, batch reaction, stirrer, explosion, spill, auto decomposition, safety procedures inadequate, overheating, thermal degradation]

Lessons

The investigation showed that the contents of the reactor had been at the solvent boiling point of 116 degrees C for 3 to 4 days. Causes for the first step of the temperature rise were probably the energy input from the stirrer with insufficient jacket cooling and a leaking steam valve on the jacket.

The second part of the temperature rise to 160 degrees C was caused by the autocatalytic decomposition of the mixture.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An 8000-litre batch reactor had been charged with a raw material and solvent when a fault on the refrigeration plant caused an interruption of the process for several days. The allegedly non-reactive chemicals remained in the reactor without supervision and with the agitator running. This had been the practice several times in the case of delays.

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60 degrees C to 160 degrees C and was still rising. Although full cooling was now applied, tar-like material was thrown out of the manhole and after a very short time the reactor exploded, although the 450mm manhole was fully open.

[storage, batch reaction, stirrer, explosion, spill, auto decomposition, safety procedures inadequate, overheating, thermal degradation, batch reactor, agitator]

Lessons

The investigation showed that the contents of the reactor had been at the solvent boiling point of 116 degrees C for 3 to 4 days. Causes for the first step of the temperature rise were probably the energy input from the stirrer with insufficient jacket cooling and a leaking steam valve on the jacket.

The second part of the temperature rise to 160 degrees C was caused by the autocatalytic decomposition of the mixture.

Source : EUROPEAN CHEMICAL NEWS, 1983, OCT, 24. LLOYDS LIST, 1983, OCT, 12, 1983, OCT, 29.

Location : Odessa, UKRAINE

Injured : 0 Dead : 0

Abstract

Millions of fish died and water supplies to two major cities were restricted when a dam burst at a fertiliser factory caused mammoth pollution of the nearby river. Thousands of tonnes of water dense with potassium salts flowed through a breach 20-60m across and 14m high in a waste product reservoir. The solution raced in a wave six metres high across 25km of countryside, crossing roads and railway lines, to empty itself into the river. More than 2,200 tonnes of fish were killed in the river as the pollution spread some 500km downstream to settle in an important freshwater reservoir which supplies water to two nearby towns. The salt solution had settled to the bottom of the dam. Good water was still available from the upper layers, however, and this was being fed to the towns, but in reduced quantities. The dam burst was the result of construction and design errors coupled with over use of its capacities.

[ecological damage, design inadequate, material of construction failure]

Lessons

[None Reported]

2665 20 July 1983

Source : INSTITUTE OF INSURERS

Location : Wilmington; California, USA

Injured : 0 **Dead :** 0

Abstract

Contractor opened a valve by mistake on a drum causing residual oil spillage which ignited.

[fire - consequence, contractor error, drums]

Lessons

[None Reported]

9729 09 July 1983

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

A plant operator fell down the stairs in a pumphouse whilst moving from the first floor to the ground floor.

The stairway down which he fell was found to be in sound condition, free from projections and clear of obstructions but, a valve key and extension tube were found on the landing at the top of the stairs.

[fall, safety procedures inadequate]

Lessons

The valve key and extension should not have been left on the landing at the top of the stairs.

1161805 July 1983

Source : LLOYDS LIST, 6 JUL, 1983, 7 JUL, 1983.

Location : ,

Injured : 0 Dead : 0

Abstract

A marine transportation incident. An unmanned offshore installation satellite gas production platform was struck by a 500 tonne gross weight cargo ship.

Damage to the vessel was reported to be slight. Damage to the platform was to be assessed.

Weather conditions at the time of were reported to be good, with reasonably good visibility and calm seas.

It was reported that the vessel had contravened the safety zones of other installations in the field.

[offshore, safety procedures inadequate, damage to equipment, navigation error]

Lessons

[None Reported]

Source : EUROPEAN CHEMICAL NEWS, 1983, 20 JUN.

Location : Botlek, HOLLAND

Injured : 1 **Dead :** 0

Abstract

During maintenance work at an ethylene metering station, an explosion on an ethylene pipeline meter occurred due to a technician slackening 4 screws from a head cap. Ethylene escaped to atmosphere and was ignited. Operator error.
[vapour cloud explosion]

Lessons

1. The bolts in question should be sealed, even if maintenance is done by experienced technicians only.
 2. At a safe distance from the metering station a motor operated valve (to be actuated locally as well as from the customer's and pipeline control rooms) should be installed in the branch off line to customer's site to minimise emission in the event of a mishap.
 3. The metering station location on customer's site was closed off by means of a 2 m high wire fence equipped with main entrance and 2 emergency exits. This to be replaced by an open-wired fence of approximately 80 cm high, to enable immediate escape.
-

2626 10 June 1983

Source : HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1983, 24 JUN.

Location : Cairo; Illinois, USA

Injured : 0 Dead : 0

Abstract

A river transportation incident. Spill of 800 ton of hydrochloric acid from river barge into river. Acid burned through a steel flange on one of two tanks onboard the barge. This was caused by the rubber gasket on the flange, that would have protected the flange from the acid, being incorrectly installed during repairs previous to the incident. Installation incorrect. Repair.
[installation inadequate]

Lessons

[None Reported]

Source : DUST EXPLOSIONS IN THE PROCESS INDUSTRIES. ECKHOFF**Location :** Stavanger, NORWAY**Injured :** 0 **Dead :** 0

Abstract

A dust explosion occurred in Norway's largest and newly built import grain silo. Although the flame propagation was considerable, the material damage was moderate due to the strong reinforced concrete structure. The event lasted 25-30 seconds during which 6-7 major explosions occurred. The flame propagated 1500 metres through a number of bucket elevators, horizontal conveyors, ducting, filters and rooms in the building. Dust explosion occurred in fifteen silos and in seven loading out silos. The six largest silos had no explosion vents whereas some small silos had vents of 0.4m² in manholes, which had their covers, flung open. Only one of the unvented large silos had its roof blown out. The other silos withstood the explosion, which would not have exceeded 0.2 barg. The legs of all of the five-bucket elevators were torn open from bottom to top. The dust extraction ducts were also in part torn open. The source of ignition was not established but could have been self-ignition of dust deposited in the boot of the elevator where the explosion was believed to have started. Alternatively it could have been initiated by welding on the outside of the grain feed duct.

[normal operations, silo/hopper, safety procedures inadequate, design or procedure error]

Lessons

Explosion vents are required in all silos, bucket elevators and dust extraction equipment.

9982 04 May 1983

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

The cleaning of a pipeline for maintenance was being undertaken by steam purging. There was high pressure created behind an isolation plug as a result of inadequate venting. The plug was ejected and a fitter suffered injury by scalding.
[cleaning procedure incorrect]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An incident occurred involving a railway maintenance contractor. Contractor's personnel had arrived on the site two days earlier and had immediately commenced a job which was pre-planned and fully covered by work permits. Having completed this work they then moved to a second job without first obtaining the relevant Work Permits.

The second job involved renewal of foundations to a length of railway track. A JCB excavator was used to remove the old foundations and in the course of this work the machine inadvertently cut through an electricity board 11KV power cable. The excavator driver escaped without injury, but he is considered very fortunate to have done so.

[excavation damage, near miss, contractor error]

Lessons

[None Reported]

Source : ICHEME

Location : , OMAN

Injured : 0 Dead : 0

Abstract

Fire occurred on a plant involving diesel. Source of ignition was hot surface.

[fire - consequence, operator error]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A road transportation incident. A delivery of industrial methylated spirits was being unloaded from a road tanker. The driver was asked to discharge part of the load into a portable plastic tank (capacity about 5,000 lit) which was supported on wooden pallets.

The driver acquired two signatures as his authority to discharge, and then started to pump into the plastic tank. When about 4,000 litres had been discharged, the tank started to make a creaking noise. The driver stopped the pump, but the tank toppled over and shattered, spilling the contents. The spill went into the factory effluent system.

[alcohol, ethanol, unloading, IBC, collapse, rupture, tank failure, standards inadequate]

Lessons

As a result of the incident, the supplier issued detailed guidance for the filling of customers' Intermediate Bulk Containers covering:

1. Material of construction and siting of IBCs.
 2. Responsibilities.
 3. Delivery equipment and driver training.
-

2466 03 January 1983

Source : ICHEME

Location : , SPAIN

Injured : 0 Dead : 0

Abstract

An explosion occurred on a refinery benzene plant reformer. Source of ignition was operator igniting furnace. Substances involved: fuel gas and methane.
[operator error, refining]

Lessons

[None Reported]

Source : ICHEME.; SAFETY AND HEALTH IN MARKETING, JAN-MARCH, 1983.**Location :** , GREECE**Injured :** 0 **Dead :** 1**Abstract**

A centrifugal separator, which formed part of the factory's central grease lubrication system, had broken down and the maintenance personnel were looking for a suspected leak. A pipe section, approximately 1 metre long, which ran through the closed separator vessel, could not be inspected unless a hole was cut in the pipe wall, 5 mm thick.

A welder was instructed to cut out a plate using an oxy-acetylene torch. After working for a few minutes a violent explosion occurred and the welder was crushed between the plate he was in the process of cutting and the separator wall.

Several pounds of grease were found to have accumulated in the pipe. The heat of the torch vaporised the heavy oil in the grease which built up to a flammable concentration and then exploded, fatally injuring the welder.

[welding, grease, explosion, fatality, cleaning procedure incorrect, inadequate procedure, centrifuge, separator]

Lessons

The of heating even small amounts of heavy hydrocarbons can give off large amounts of vapour which on mixing with air can become explosive. Under these circumstances heavy products can be even more hazardous than light products such as motor spirit because heavy oils do not reveal their presence under explosimeter tests and this can result in a false sense of security. If surfaces which are to be heated cannot be cleaned thoroughly then the heating should be carried out under a continuous purge.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A vent on a diesel fin fan cooler was left open at the end of a shutdown. The normal leak testing did not detect this for reasons unknown. The leak ignited on a hot surface before it was detected.

[diesel, start-up, vent, spill, fire - consequence, safety procedures inadequate, operator error]

Lessons

1. When air testing for all parts of the unit must be checked. This vent was in fairly remote location on the inlet header to a fin fan cooler above a high pipe rack.
 2. During start-up it is important for the outside operator to be alert for leaks.
-

122951983

Source : ICHEME

Location : ,

Injured : 0 Dead : 1

Abstract

A contractor's supervisor was killed when he became trapped between the moving counterweight and an outrigger part of the crane whilst he was watching material being lifted from a lighter by a mobile crane belonging to his company.

[safety procedures inadequate, fatality]

Lessons

[None Reported]

Source : HAZARDOUS MATERIALS INTELLIGENCE REPORT, 17 DECEMBER, 1982.

Location : Palo Seco, PUERTO RICO

Injured : 0 **Dead** : 0

Abstract

Approximately 13,000 gallons of 50 percent sodium hydroxide solution spilled into a nearby river when a worker inadvertently allowed a tank to overflow during as offloading operation.

Apparently the incident occurred when the worker left his station during offloading pf a portion of a 19,000-gallon cargo of sodium hydroxide solution into an 800-gallon tank.

[operator error, unloading, pollution]

Lessons

[None Reported]

Source : ICHEME

Location : , BAHRAIN

Injured : 0 **Dead :** 0

Abstract

Machinery breakdown on a reformer on a refinery hydrogen plant due to operator error.

[mechanical equipment failure, refining]

Lessons

[None Reported]

Source : ICHEME

Location : , USA

Injured : 0 Dead : 0

Abstract

Start-up was underway following a 3 week turnaround. Water batching was in progress and the initial water charge had been processed through an autoclave, through the crystalliser, and was in the filter tank. The next step was to transfer the water batch under pressure from the filter tank to the ammonia still. The operator began heating the water batch and when the temperature reached 150 degrees C, he lined up the correct valves to the ammonia still and steamed the line. He then applied the customary 110 psig steam pad to the filter tank and began transfer. All conditions were apparently normal. Approximately ten minutes into the transfer, the ammonia still ruptured, spraying hot water and steam from a vertical crack in the sidewall of the vessel. The crack extended from the bottom dish to the top head and was approximately 6 inch wide at the middle of the tank. It was found later that the pressure was 20 psig and the temperature was 118 degrees C, and that the rupture disc was found to be intact.

The cause of the rupture, which was at well below normal operating pressure, was due to corrosion of the steel tank sidewalls. This had occurred when the brick lining had become cracked and the corrosive liquid was able to seep through to the metal.

[ammonia, corrosion, inspection inadequate, rupture, still, material transfer, low pressure]

Lessons

The following recommendations included:

1. The method for evaluating the condition of brick lined vessels in pressure service should be improved and include an accurate assessment of the substrate steel thickness and strength.
 2. Consideration should be given to replacing these vessels with alloy metals.
-

2410 27 October 1982

Source : ICHEME

Location : , SOUTH KOREA

Injured : 0 Dead : 0

Abstract

Machinery breakdown on a refinery utilities plant caused by operator error. Equipment involved, transformer.

[mechanical equipment failure, refining]

Lessons

[None Reported]

2404 07 October 1982

Source : ICHEME

Location : , VENEZUELA

Injured : 0 Dead : 0

Abstract

An explosion at a refinery crude distillation plant involving a furnace, fuel gas and methane. Source of ignition was operator igniting furnace.
[refining, operator error]

Lessons

[None Reported]

Source : ICHEME**Location :** , UK**Injured :** 0 **Dead :** 0

Abstract

Propane loading to a marine tanker was completed at a loading jetty at the refinery using two loading arms. On completion the jetty head valves, the ship's valves and the double ball valves fitted at the end of the loading arms were closed, the latter by hydraulic operation. The pipeline was cleared of the remaining propane and filled with butane. The loading of the butane commenced after opening the jetty head valves, the ship's valves and the hydraulically operated double ball valves of two loading arms. Five minutes later the jetty operator heard a bang and observed a cloud of vapour obscuring ship/shore loading area. He operated the emergency shutdown button and closed all jetty product and vapour return valves. The ship's crew shutdown all of their own systems. The fire pump and jetty monitor systems were activated. In 5 minutes the vapour cloud had dispersed. It was then observed that the emergency release coupling fitted to one of the loading arms had parted without the hydraulic control system being operated and that the ball valves were in the open position. The gas detectors fitted to the base of the loading arms and to the wall of the jetty head control building did not operate. The loading arm is a MKIV Autosimplex low temperature type 10 inch/6inch nominal bore designed to accommodate tankers 200 to 6,000 tonnes deadweight and to allow for drift. An audible and visual warning system is fitted. It was concluded that:

1. The emergency release coupling inadvertently broke free because each time the ball valves were hydraulically operated oil leaked from that system through the sequence block into the ram cylinder which operates the release mechanism. With each movement of the ball valves hydraulic system the oil leaking into the release cylinder caused the arm to creep forward until enough forward movement was built up to eventually operate the mechanism and release the coupling.

2. When the emergency release coupling freed itself the arm was under load conditions and on freewheel. This caused the arm to drop and strike the vessel's structure, fortunately without producing an incendive spark.

[butane, processing, material transfer, terminal, loading arm, environmental, design inadequate]

Lessons

The following recommendations were made:

1. The emergency release coupling hydraulic system remain isolated until such time as a safe system is proven.

2. The operation of the release procedures be further investigated to ensure safe operation by possibly reducing the procedure for release and holding the boom in a static position.

3. All jetty head gas detectors be checked to ensure that they are in working order. Subsequently it was decided that the safest method of operation until redesign was to disconnect and blank-off the hydraulic supply line to the quick release coupling hydraulic actuator. This meant that the facility for releasing the tanker from the arm in an emergency was not available. In the long term a new design was required.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A 3,500 cubic metre refrigerated LPG carrier was part way through its loading programme when the emergency release systems, installed at the jetty loading arm, parted without any initiating action having taken place and with the double ball valves open. A release of refrigerated butane occurred which was only stopped by the manual activation of the jetty shutdown system and closure of the ship's manifold isolation valves. The jetty head firewater monitors were switched on and the vapour cloud which had formed dispersed without incident in about 10 minutes. No injuries were reported.

An investigation into the incident concluded that the hydraulic sequence valve had been passing thus admitting hydraulic oil pressure to the emergency release system (ERS) coupling actuator when the ball valves were opened. However, in order to allow sufficient pressure to build up to cause the (ERS) coupling to release it was necessary for a bleed off facility, designed to prevent such an occurrence, to become inoperable. Subsequent examination revealed that a non-return valve had been fitted into the bleed off system in error and in such a way that no flow back into the bleed off system in error and in such a way that no flow back to drain was possible in the bleed off line.

[refrigeration unit, gas / vapour release, installation inadequate, marine tanker]

Lessons

[None Reported]

1000901 August 1982

Source : ICHEME

Location : , TANZANIA

Injured : 19 Dead : 71

Abstract

An LPG explosion occurred which left 71 people dead and 19 seriously injured. The accident took place at a textile factory which used LPG from two skid mounted tanks.

It was believed that an electrical fire occurred in the works area and, as a safety precaution, the factory engineer had one of the tanks disconnected and towed away to a safe area. The other tank was empty at this time. After the fire had been successfully extinguished the engineer decided to move the tank back into position. On this occasion it proved too heavy and he decided to lighten it by venting the contents to atmosphere. A cloud of gas drifted towards a restaurant some 30 yards away where it was ignited by a cooking fire and a violent explosion occurred.

[LPG, fatality, competency lacking, operator error, vapour cloud explosion, gas / vapour release, hot surface, injury]

Lessons

This accident was caused by a lack of knowledge about the characteristics and physical properties of LPG on the part of the factory engineer.

Source : ICHEME

Location : , SWITZERLAND

Injured : 0 Dead : 0

Abstract

An incident occurred in a laboratory which involved the release of a small quantity of ethylene oxide which triggered the alarm system in the building.

Evacuation of all personnel occurred followed by emergency team intervention to make the area safe.

Two laboratory workers wearing breathing apparatus were in the act of attaching a full 2 litre cylinder of ethylene oxide to the alkoxylation reaction system when the spring relief valve of the top valve was mistakenly removed. This allowed ethylene oxide liquid to escape, vaporise and the air flow in the lab swept the gas into the ducting system where it activated the electro-catalytic gas detector system.

The building was evacuated and the cylinder was taken outside and immersed in water to dilute the ethylene oxide which remained inside.

The cause was found to be operator error, but the investigation committee reasoned that there were two reasons for this:

1. Insufficient training of the procedure to be used for the operation.

2. Inadequate procedures and supervision.

[ethylene oxide, laboratory work, operator error, safety equipment failure, gas / vapour release]

Lessons

Recommendations made to prevent recurrence included:

1. A formal programme of operator instruction must be developed and implemented for all present and future operations involved with the alkoxylation equipment.

2. A formal line management authority must be established and made known. This authority should encompass the following activities:

· Operator training manual development and updating.

· Implementation of operator training.

· Assessment of operator knowledge.

· Formal recording of operator capability.

· Approval and cataloguing of equipment modifications and associated safety systems.

3. A modification to the ethylene oxide bombs should be that the security valve is identified as 'not to be removed' and that the connecting ports be identified and protected by plastic inserts

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A release of propylene occurred during maintenance, due to operator error and inadequate modification procedures.

An entry was made in the 'Night Order Book' to have the gland on a gate valve on the propylene main repacked. The following morning the utilities deputy Senior Operator and his Foreman went through the items in the Night Order Book. The Foreman was uncertain about the exact identity of the valve, but the Senior Operator was satisfied that he knew which the valve was. They went to the end of the 3 inch propylene line referred to in the Night Order Book at 'J' Storage from where the line had been purged with nitrogen and where there was a pressure gauge which at that time read 15 psig.

At this point the Foreman left the factory. The Senior Operator proceeded alone. He made out a permit-to-work for a Fitter. When the Fitter began loosening the valve bonnet bolts there was an escape of liquid, which the Fitter thought to be propylene, but the Senior Operator suspected was nitrogen. The Fitter tightened up the valve bonnet and the Senior Operator went to recheck the system. The Senior Operator went to the cumene plant control room where he asked the Foreman whether there could be gas coming from the plant into the propylene main. He was told that there could not, because the plant was shut down. He then followed the line from the cumene plant back past the valve he was interested in until he found it ending in a blank. The blanked line is described on an adjacent stanchion as '2' propylene. This convinced him that the gas at the valve bonnet had not come from the cumene plant side of the valve. He went to 'J' Storage where he found that the pressure in the 3 inch propylene line was now 55 psig. He asked for this line to be vented down, and after a time went back to the 'J' Storage gauge. The pressure now being 5 psig, he assumed that all was now well and told the Fitter that it was safe to proceed. He did not accompany the Fitter to the valve.

The Fitter had a permit-to-work allowing him to repack the valve gland without any caveat. He removed two of the four bolts, securing the valve bonnet and loosened the other two. He then broke the bonnet joint, allowing significant amounts of liquid propylene to escape. The resultant cloud of vapour reached up to 20 feet at its source, was about one foot high and breaking up 200 feet downwind, and at its widest point was about 50 feet across. Between 1 and 1.5 tonnes of propylene escaped over a period of 7-12 minutes. There was no ignition.

The leak was efficiently isolated and the valve temporarily secured.

[spill, design or procedure error]

Lessons

Steps to be taken to ensure that Foremen and Operators get suitable and continuing experience in operating the utility network.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

Approximately 3,500 gallons of caustic soda was released from a high point vent on a vinyl chloride monomer (VCM) plant. No-one was injured. The release was due to operator error, setting valves incorrectly. The man compounded the error by not reporting the release.

[spill]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 1 Dead : 0

Abstract

An operator using a high pressure water jet to clean the tubes of a reboiler had inserted the lance into the top few inches of the blocked tube. When the lance was pressurised, it flipped out of the tube causing the operator to step backwards and out. He stumbled against the lip of the reboiler, momentarily losing control of the lance. The water jet inflicted a minor cut to his foot before the second operator on the emergency dump valve had time to operate it.

[cleaning, safety procedures inadequate, people]

Lessons

[None Reported]

Source : HAZARDOUS CARGO BULLETIN, JUNE 1982, PAGE 26.

Location : New Orleans, USA

Injured : 1 Dead : 0

Abstract

A river transportation incident. A 138,000 dwt river tanker carrying crude oil was travelling up the Mississippi River in fog. The vessel collided with a tug and three barges. The tug and three barges, loaded with fuel oil, escaped with minor damage but the collision caused a gash in the large tanker. Crude oil poured out and ignited, spreading out on the river. One crew member suffered injury. The ship was severely damaged in the fire.

Failure to establish proper communications between the ships may have been a contributory factor to the accident.

[operator error, collision, river transport, damage to equipment, injury]

Lessons

[None Reported]

Source : ICHEME**Location :** ,**Injured :** 1 **Dead :** 1

Abstract

In order to improve the security of product in transit, it was decided to install wooden cross bars in the man holes of road tankers. This work involved welding to hold the cross bars and it was decided to gas free the vehicles by arranging for them to carry a cargo of gas oil before installing the cross bars. On Saturday the tanker in question was loaded with gas oil in preparation for welding. The following Tuesday the driver was asked to take the allegedly empty vehicle to the workshop of a local contractor. Contrary to instructions no representative from the vehicles owners were present. The welder asked the driver what was the last product loaded into the tank and it was confirmed that it was gas oil. The welder then proceeded to install the holding brackets with the loading hatches open. The welder successfully completed three compartments but, as he was chipping the slag off on the fourth compartment an explosion occurred. Both the welder and assistant received serious burns, with the welder later dying of his injuries.

[road tanker, inspection inadequate, testing inadequate, gasoline, fatality, welding, injury]

Lessons

The tanker was found to contain motor spirit and it was concluded that the driver may have made an illegal trip to carry motor spirit prior to taking the vehicle to the contractors shop. Recommendations included that welding work of this nature should be done under careful supervision and then only after gas freeing and thorough checks. Further, no hot work should be carried out until all traces of oil or flammable materials have been removed from the surfaces to be heated.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

After separation in a thin-film evaporator, the bottom product was conveyed towards a control valve by a worm screw pump. The system had to be held at above 250 degrees C to keep the bottom product liquid by a diphenyl heating oil at 290 degrees C.

One day the product line burst between the screw pump and the control valve. The heating oil was released into the room.

The cause of the incident was a plug in the control valve. The trapped product was heated up by energy input from the pump and subsequently by heat of decomposition.

[material transfer, overpressure, gas / vapour release, pump dead headed, design inadequate, blockage by polymer]

Lessons

To prevent recurrence, the installation was modified so that the screw pump could no longer work against a closed or plugged control valve. In addition, pressure and temperature controls and a rupture disc were fitted.

1000725 February 1982

Source : ICHEME

Location : Melbourne, AUSTRALIA

Injured : 0 Dead : 0

Abstract

About 670 tonnes of vinyl chloride monomer (VCM) escaped from a storage sphere at a petrochemical plant. A main valve of the sphere opened after piping attached to the valve was disconnected for maintenance. When the piping was removed, a heavy steel actuating cylinder was left hanging unsupported on the operating lever of the valve. The cylinder eventually dragged the valve open, allowing gas to escape.

The gas escaped in the form of a strong liquid stream that boiled, producing large volumes of vapour as it spread across the floor of the retaining compound beneath the sphere. The vapour was carried away by the prevailing southerly breeze and dissipated across vacant land to the north of the chemical plant.

[vinyl chloride monomer, VCM, storage sphere, maintenance inadequate, gas / vapour release]

Lessons

The recommendations included:

The provision of two valves, one manual and one remote-operated. On all main connections of large liquefied gas vessels where the connection does not have an automatic device to preclude accidental outflow.

The preplanning of emergency operations between the company and emergency services, should include the implementation of large scale simulation exercises.

2334 09 February 1982

Source : THE EXPLOSION DISASTER IN BRUCHKOBEL, HSE TRANSLATION 85/1

Location : Bruchkobel; Maine-kinzig, GERMANY

Injured : 0 **Dead :** 0

Abstract

An explosion occurred at a perfumery aerosol filling station. A master valve and one valve at the filling machine were found to be open and a flexible hose screwed connection was found loose causing propane/butane to escaped into the building. The mixture was ignited by a cigarette lit in the recreational area. The explosion destroyed the building.

[leak]

Lessons

[None Reported]

Source : ICHEME

Location : , CANADA

Injured : 0 Dead : 0

Abstract

At 5pm, the flame of a flare stack was extinguished. As a direct result of an abnormal operating condition at the cat cracking unit and because acid gas was being flared at the time, the flameout resulted in a significant release of hydrogen sulphide gas which led to a nearby traffic highway to close until the gas dispersed.

The immediate causes of the incident were attributed to a failure of a light ends drum level controller which led directly to an unstable fuel gas system and excessive flaring. To cope with the flaring, excessive steam was used to control smoking and when flaring stopped abruptly, the steam contributed to snuffing out the flame. The basic cause was the inadequate design and operation of the pilot gas system. Underlying causes were lack of training and skill for pilot reignition and minimal routine checking and maintenance. Two motorists were reported to have been affected by the gas while driving on the highway. [design inadequate, training inadequate, maintenance inadequate, inspection inadequate, flameout, mechanical equipment failure, gas / vapour release]

Lessons

Immediate corrective steps were that acid gas stream to the flare would be eliminated and that acid gas would not be produced until the sulphur plant was restarted. H₂S production was minimized and there was an immediate review of the flare reignition procedures and facilities. Appropriate personnel were retrained in the use of these facilities.

Recommendations were:

1. A review of flare ignition procedures and proper pilot operating conditions
2. Retraining of all process personnel
3. Establishment of an emergency procedure to deal with a flare flameout
4. Development of a regular inspection of the pilot system and the ignitor system as a preventative maintenance program for pilot gas regulators and ignition equipment
5. Development of guidelines to deal with an emergency sulphur plant shutdown

Improvements to facilities were recommended to:

1. Installation of a pressure regulation system for pressure control of the pilot gas at the burner.
2. High and low pressure alarms were provided on the pilot gas downstream of the regulator to warn the operators in the control room and an automatic backup fuel gas system was also provided.
3. Dual pilot flame detection thermocouples were installed on each of the 3 pilots so that a low temperature alarm in the control room if the flare and the pilots were extinguished.
4. Facilities were provided to automatically add fuel gas to the flare whenever acid gas needed to be flared on an emergency basis
5. Thermocouple installation to detect a pilot flameout.
6. Installation of an infra-red detection device which can operate in all weather conditions.
7. The establishment of a need for an alternative facility for the incineration of acid gas.

2325 01 February 1982

Source : ICHEME

Location : , ISRAEL

Injured : 0 Dead : 0

Abstract

Product loss at a plant storage involving a floating roof tank and naphtha.
[operator error]

Lessons

[None Reported]

2315 08 January 1982

Source : ICHEME

Location : , ZAMBIA

Injured : 0 Dead : 0

Abstract

An explosion and fire at a petrochemical nitric acid plant involving a reactor and ammonia. Source of ignition was hot surface.
[fire - consequence, operator error, reactors and reaction equipment]

Lessons

[None Reported]

122911982

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

An instrument technician received chemical burns when he mistakenly unfastened the flange units securing a thermowell to the tank nozzle instead of the union nuts for removing the thermocouple.

The thermowell slid fortunately only part way out under the pressure of the tank contents.

[operator error, maintenance, unknown chemicals]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

To carry out maintenance on a seal oil system a flange was broken but this was on the live side of the closed isolation valve. The leak ignited.

[hydrocarbon, flange, blowout, fire - consequence, identification inadequate, safety procedures inadequate]

Lessons

The operator must either show the maintenance crew what to do directly before the work commences or very clearly label the items to be worked on.

The operator should also check by opening a vent or reading a pressure gauge on a vent, that the equipment to be worked on is not under pressure.

The maintenance charge hand should witness the above check.

122941982

Source : ICHEME

Location : ,

Injured : - Dead : 6

Abstract

A fire and explosion occurred in a polypropylene plant killing six employees and injuring several others. Sever plant damage was reported.

An accidental escape of combustible material during maintenance is thought to have been the cause.

The incident occurred when a fitter has mistakenly disassembled a 4-inch plug on a live reactor circulation line. This caused the plug to be blown out creating considerable amount of combustible material.

[fire - consequence, damage to equipment, process causes, fatality, operator error, reactors and reaction equipment, injury]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 2

Abstract

Two workers were killed during welding operations when hydrocarbon vapour was blown over them and ignited resulting in fatal burns.

[fatality, safety procedures inadequate]

Lessons

The report stated the following:

1. Drain systems are a potential hazard when welding is to be carried out. Hydrocarbons can easily collect in open and underground drain systems when there is little or no flow. Their presence may also remain undetected during gas testing of the drain system in the vicinity of the place where welding has to be carried out.
 2. If under such circumstances a lot of water is suddenly drained into the system, e.g. from steaming out operations, the trapped hydrocarbons may evaporate causing an escape of flammable vapours in the area of the hot work.
-

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

While shutting down a catalytic polymerisation unit temperature changes include induced thermal shock in a reactor feed/product exchanger. The tube sheet joint leaked propane. This was ignited from an undetermined source.

The unit had been through many shutdowns previously without incident.

[propane, shutdown, shell and tube heat exchanger, blowout, fire - consequence, thermal expansion, maintenance inadequate]

Lessons

Shutdown procedures had been normal and so maintenance procedures for making up exchanger flanges evenly were tightened up. This exchanger had been opened up for cleaning at the previous shutdown.

2284 29 November 1981

Source : ICHEME

Location : , JORDAN

Injured : 0 Dead : 0

Abstract

An explosion at a refinery hydrotreater plant involving a furnace and hydrogen caused by faulty operation. Source of ignition was furnace.
[refining, operator error]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

An audit test in a one litre reaction vessel was being carried out when foaming occurred. The technician added the incorrect antifoam causing a violent reaction to take place resulting in the ejaculation of a hot solution.

[testing, reactors and reaction equipment, unwanted chemical reaction, spill, operator error, diethyl sulphate]

Lessons

Better training required to differentiate between antifoams. Procedure should be modified to avoid adding antifoam at higher temperatures.

1164228 October 1981

Source : ICHEME

Location : , ITALY

Injured : 0 Dead : 0

Abstract

A marine transportation incident. A fire and explosion occurred onboard a marine tanker. Following the explosion 42 members of the crew and passengers who had abandoned the vessel were recovered by another vessel. The marine tanker had 9 crew still on board and sailed under its own steam. The vessel was loaded in Canada with styrene, xylene, toluene, benzene and a mixture of xylene and toluene. These products were discharged at various ports except for the xylene/toluene mixture. The tanks were ballasted. The tanks were not checked for the atmosphere contents. A low order explosion occurred followed by a second and third explosion 30 seconds later, the third explosion was the strongest.

An investigation was carried out and it was found that:

The first explosion occurred in the tank which was being steam cleaned and which probably had a flammable atmosphere. This then propagated to the other tanks.

[fire - consequence, cleaning procedure incorrect]

Lessons

Steam cleaning of tanks is not recommended in the operating procedures when there is likely to be a flammable atmosphere present.

2257 15 September 1981

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, SAFETY RECOMMENDATIONS H-82-1 TO H-82-3.

Location : Jordan Lane; Huntsville; Alabama, USA

Injured : 4 **Dead** : 7

Abstract

Road transportation/rail transportation. A road tanker was struck at a level crossing by a freight train causing rupture and spillage of gasoline which ignited. The cause of the accident was failure of the driver to comply with the activated crossing warning signal. Fatality.
[fire - consequence, operator error]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

During the start-up of a propylene hydrogenation reactor, very high temperatures were generated in the catalyst bed. At the time, propylene and hydrogen were being fed to the reactor which contained a granular catalyst. The temperature rose rapidly, and the hydrogen supply valve tripped at 176 degrees C. Despite the removal of the reactant supply, the temperature continued to rise to more than 600 degrees C, only stabilising after the reactor had been isolated and depressurised.

It was concluded that the start of the incident was caused by wrongly setting the propylene/ hydrogen ratio as a result of faulty calibration of the flow instruments. This allowed the temperature to rise to the point where spontaneous exothermic polymerisation of propylene occurred.

Investigation of the incident was hampered by the loss of the relevant instrument record charts.

[processing, reaction, polymerisation, exothermic reaction, control failure, incorrect flow rate, reactors and reaction equipment, design or procedure error, competency lacking, fire - consequence, damage to equipment]

Lessons

The following recommendations were made:

1. Stops should be fitted to key controllers/valves to limit flows in the event of a malfunction.
 2. Situations where hydrogenation reactors are isolated or have only low flows through them during commissioning, maintenance or other operations should be identified and avoided.
 3. The integrity of the trip system should be improved.
 4. Good maintenance procedures are required to avoid the possibility of incorrectly calibrated transmitters being returned to process.
 5. All records should be retained for a period, and should an incident occur, all relevant records should be impounded immediately.
-

2250 25 August 1981

Source : PIPELINE ACCIDENT REPORT NATURAL GAS PIPELINE PUNCTURE, NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, REPORT NUMBER NTSB-PAR-82-1, 1982; HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1982, 2 APR.

Location : San Francisco; California, USA

Injured : 0 **Dead :** 0

Abstract

An excavator's drill ruptured a 16 inch natural gas pipeline, causing a release of polychlorinated biphenyls (PCBs). PCB contaminated gas continued to escape for nine hours whilst workers searched through out of date records to locate an emergency valve that had been paved over and attempted to close another emergency valve that was malfunctioning because of inadequate maintenance. Thousands evacuated. The puncture of the pipeline was due to failure of the general contractor to comply fully with the terms of the excavation permit which required him to verify the location of underground facilities that might be affected by the project. Contributing to the accident was the failure of the subcontractor, who knew of the existence of the gas pipeline, but not its exact location, to ascertain that the gas company had been notified before commencing excavation. 30,000 evacuated.

[contamination, operation inadequate, contractor error, evacuation]

Lessons

[None Reported]

Source : ICHEME**Location :** , UK**Injured :** 1 **Dead :** 0**Abstract**

On 12 August 1981, a contractor working on the site of a large chemical company was overcome by chemical fumes whilst working inside a vessel. Fortunately he was rescued, but not without difficulty, and subsequently recovered.

The man was re-coating the inside of the vessel with a mixture of rubber and resin dissolved in toluene. A gas test on the vessel, a Vessel Entry Certificate and a Permit to Work had all been obtained. The safety requirements had been stipulated, and included the need to wear protective clothing, air supplied face mask, the provision of a fresh air line into the vessel to give forced ventilation, explosimeter tests, and the need for an observer outside the vessel.

A number of the safety conditions were broken. The man entered the drum without a mask (it was handed down to him, but there is doubt as to whether he put it on). A dedicated observer was not present. There was no air line into the vessel. Explosimeter tests were not conducted.

A colleague, alerted by the lack of activity in the vessel looked in and saw the collapsed contractor. He then entered the vessel without mask or harness, failed to lift the contractor, and had to leave the vessel because the fumes were overwhelming. The site emergency services were summoned, but their arrival was seriously delayed because the telephone was faulty and they did not hear the nature or location of the emergency. Finally, the rescue was made more difficult because the contractor was not wearing a harness. When he started to revive in the fresh air he became violent and abusive, and had to be physically restrained.

[maintenance, entry into confined space, repair, air line, breathing apparatus, tank, asphyxiation, operator error, shift change, competency lacking, maintenance procedure error, contractor error, atmosphere not tested, management system inadequate, permit to work system inadequate]

Lessons

The following recommendations were made:

The report:

1. Emphasises the need for implementing fully the requirements of the Permit to Work and related certificates.
2. Recommends a clear requirement to use harnesses.
3. Emphasises the need for a caller reporting an emergency to wait until the fireman on duty repeats any message.
4. Asks for the findings to be relayed to the contractors.

In addition, the main body of the report makes it clear that the supervision of the job was less than satisfactory. This was exacerbated by the timing of the work which was started just before a shift change-over.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A road transportation incident. A gas tanker arrived at the LPG Loading Point No. 4 to be filled with propane. On completion of loading. The hoses were valve isolated and were left depressuring to the flare whilst the morning shift operator handed over to the afternoon shift operator.

Before the afternoon shift operator had time to go to the tanker, the driver reported he had driven off without the hoses being disconnected. There was no leakage of propane as the system was fully depressured. The filling and vapour hoses were damaged and subsequently scrapped, both vapour and filling couplings were broken and scrapped, the steel vapour return line was damaged and was removed, pressure tested and returned to site.

The tanker driver left site as soon as the hoses were disconnected before refinery personnel could check for damage to the tanker.

[damage to equipment, operator error]

Lessons

Consideration should be given to physical systems, e.g. barriers or interlocks to prevent potentially serious incidents which could result from failure to follow operating instructions

Source : ICHEME

Location : , NETHERLANDS

Injured : 0 **Dead :** 0

Abstract

Fire at a refinery depentaniser plant involving condensate in column, cause, faulty instructions.

[fire - consequence, refining]

Lessons

[None Reported]

Source : HAZARDOUS CARGO BULLETIN, SEPT, 1981,; LLOYDS LIST, AUGUST, 1981.

Location : , PORTUGAL

Injured : 2 **Dead :** 1

Abstract

A quick release connection failed on refrigerated, semi-pressurised propylene cargo ship discharge arm resulting in one fatality and several injuries. The liquified gas was sprayed out in all directions at -48 degrees C. Shore staff who were injured were found not to be wearing appropriate protective equipment and where exposed to frostbite and asphyxiation. It is not clear whether the cause of the incident was due to equipment failure or operator error.

[mechanical equipment failure, refrigeration unit, fatality, safety procedures inadequate, people, gas / vapour release, unloading, marine transport, injury]

Lessons

The Marine Safety Committee had accepted in 1980 guidelines from the International Chamber of Shipping (ICS) outlining model forms to be followed as checklists prior to commencing offloading operations. It is not clear whether these were followed in this case.

2234 30 July 1981

Source : LLOYDS LIST, 1981, 1 AUG.

Location : Mantua, ITALY

Injured : 1 **Dead** : 3

Abstract

Oil tank explosion when men were repairing a purification duct on top of a tank. Explosive gas formed in the duct, igniting the oil. Maintenance repair. Fatality.
[repair, faulty instructions]

Lessons

[None Reported]

Source : ICHEME.; LLOYDS LIST, 1981, 25 JUL.

Location : California, USA

Injured : 2 Dead : 0

Abstract

Isolation of slurry pump at base of catalytic cracker by fitting a blind was being carried out. Oil sprayed out, ignited and caused a major fire. Source of fuel was the catalytic cracker column slurry. 13 lines containing hydrocarbons failed in the fire area. An 18 inch valve was found open in the suction line of pump. [fire - consequence, cracking, slip plate insertion/removal, blind/spade/slip plate, isolation inadequate]

Lessons

[None Reported]

2204 31 May 1981

Source : MARINE ACCIDENT REPORT EXPLOSION AND FIRE ON BOARD A TANKSHIP, NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C., USA, REPORT NUMBER NTSB MAR-81-14, 1981.

Location : Port Arthur; Texas, USA

Injured : 0 **Dead** : 0

Abstract

A marine transportation incident. A marine tanker was in idle status with a small maintenance crew on board. The vessel had no cargo but was not gas free. At the time of the initial explosion welding was in progress in the engine room on auxiliary bilge discharge line which was connected to a tank via a valve which was open. The probable cause was failure of the crew to maintain a gas free tank.

[atmosphere not tested]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A member of staff began to prepare a solution of sodium dichromate in 85% formic acid, acting upon instructions from the graduate chemist. Approximately 100g of dichromate had been weighed into a flask and after adding 500ml of formic acid, the technician observed that the mixture had started to effervesce. He quickly placed the flask in the adjacent sink and withdrew. Foaming continued for a few minutes and there was some splashing onto the drainer and back wall. The incident arose through an attempt to mix chemicals which were incompatible. The consideration of the question of chemical compatibility would appear to be a weak point amongst the division's staff. There is a surprising lack of knowledge of fairly elementary chemistry. The problem may partially stem from a failure to recognise that some fairly common academic laboratory/titrimetric reagents are potentially explosive if prepared in higher concentrations or larger quantities. A number of operations ancillary to the main experiment possibly receive too little attention in the assessment of chemical and operational hazards. [sodium dichromate, formic acid, mixing, flask/container, spill, chemicals added incorrectly, faulty instructions]

Lessons

It was recommended that:

1. The incident and report should be publicised
 2. The work safety sheet for methanol oxidation and immediately related operations should be updated
 3. Divisional graduates should review current work safety sheets to ensure that any questions of possible incompatibility are covered
 4. Bretherick's handbook on reactive chemical hazards should be publicised (maybe made available to each individual laboratory)
 5. Information on incompatibility should be included in any future divisional safety induction course for new graduates
 6. A divisional note on common instances of incompatibility should be issued
 7. Consideration should be given to a divisional presentation on incompatibility for graduates and other staff.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

During excavation work on, for the installation of posts for an Alkylation Unit Flare Line, an underground 3.3.

KV Feeder cable to a Catalytic Reformer 2 and two pilot cables were severely damaged. The mechanical post hole digger being used struck an obstruction below ground level and a contractor commenced breaking up the obstruction with a steel bar by repetitive driving blows. Pieces of the obstructing material were found to be parts of a cable tile. There had been no immediate indication of damage to cables, and the discovery was made about twenty-four hours later, followed checking out the cause of an earth fault.

[damage to equipment, operator error]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

Road transport. A 36,000 litre road vehicle was being filled with distillate at a vehicle loading gantry after a previous load of premium petrol. The driver drained the tank compartments to conform to switch loading requirements and after a delay to carry out running maintenance on the vehicle top loaded the distillate via a loading arm with a flexible hose and camlock coupling. He filled two compartments and moved the vehicle to allow filling of the others. After connecting the filling hose and reconnecting the static wire, the driver continued filling and 10 to 15 seconds later, an explosion occurred in the compartment, resulting in a flash through the open tank. The explosion seems to have been a typical switch loading accident caused by the electro-static generation due to a high flow rate. It appears that established procedures for switch loading were not fully followed in this incident.

[flow rate too high, additional incorrect operation, gasoline]

Lessons

The explosion seems to have been a typical switch loading accident caused by electro-static generation due to a high flow rate. It appeared that established procedures for switch loading were not fully followed in this incident.

Source : ICHEME

Location : ,

Injured : 0 Dead : 2

Abstract

In order to replace the gasket of a road vehicle tank manhole, the driver and a mechanic were attempting to remove the manhole cover. Considerable force, which may have involved a hammer, was apparently applied to loosen one of the retaining bolts. At this moment an explosion took place inside the tank compartment which killed both men, destroyed the vehicle, extensively damaged the workshop and shattered windows in nearby offices. Apparently the tank, which had previously carried gasoline, had not been cleaned or gas freed since no 'hot' work was to be done.

[inadequate cleaning, operation omitted, cleaning procedure incorrect, damage to equipment, fatality]

Lessons

This incident was unusual as research has shown that the hand held tools used were not capable of creating an incendive spark when impacting steel. It is however possible that there may have been a chip of silica or some other hard material such as flint embedded in the head of the hammer which caused the friction spark. Vehicles should be gas freed before any maintenance is carried out on the tank involving the use of major force.

Source : ICHEME**Location :** ,**Injured :** 0 **Dead :** 0

Abstract

Construction work linked with a modernisation 'project' had been stopped prior to the discharge of a parcel of aviation fuel from a marine tanker. After the line had been cleared of water, pumping of the aviation gasoline commenced. The operator then began to drain water from the motor gasoline tank by opening two drain valves (4 m apart) at the same time. While supervising both the tanker discharge and water drainage operations, the operator was suddenly surrounded by flames coming from the concrete drainage channel around the tank and leading to the oil/water separator. He was only able to close one of the two drain valves. The fire subsequently grew and the fire fighting water supply ran out (owing to a major part of the reserve stock having been used up by the construction contractor). The ensuing conflagration eventually spread to other tanks and was not totally extinguished until some thirty hours later.

[fire - consequence, aviation fuel, gasoline, lack of fire water, contractor error, inadequate supervision, electrical spark, loading/unloading]

Lessons

It was concluded that the poorly supervised drainage operation allowed gasoline to escape with the water and the source of ignition was thought to be electrical sparking when the water reached a badly maintained welding cable. Although the contractor had stopped welding he had not isolated the supply to the welding machine near the motor gasoline tank. Further, reserve water for fire fighting should never be used for any other purpose.

Source : ICHEME

Location : , USA

Injured : 7 Dead : 0

Abstract

A 8 feet diameter, 50 feet long horizontal propane tank on a refinery was taken out of service for repair. As was standard practice the tank was neutralised, flushed and steamed prior to checking by the Safety Department. The tank was tested for oxygen, hydrocarbons and hydrogen sulphide, all parameters were satisfactory and the men were permitted to enter the tank through the 18 inch top manway wearing boots and slicker suits to clean the remaining sludge. Two men entered the tank, a third followed shortly after but experienced a "funny" taste in his mouth and felt nauseous. He called to the other two men to get out, turned and climbed out the manway. The alarm was raised and several men entered the tank with and without breathing apparatus to rescue men. A total of seven men were taken to hospital after being affected by hydrogen sulphide fumes. An investigation revealed a number of deficiencies in procedure namely; no analysis of sludge, no planned rescue procedure, no lifeline attached to employees sent into confined tank, inadequate training of employees regarding hydrogen sulphide and training inadequate in the use of breathing apparatus.

[refining, entry into confined space, atmosphere not tested, poisoning]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A fire occurred whilst rehabilitation work was in progress on a floating roof tank. Approximately two thirds of the roof had been cut away using oxyacetylene equipment. Three contractor employees were working on the top of a remaining segment of the tanks roof when a flash fire occurred. This ignited sludge and oily deposits clinging to the shell and floor of the tank and a substantial fire developed. No one was injured in the incident.

It appears that the initial flash was caused by a leaking acetylene hose.

Hoses from gas cylinders were taken into the work area on the roof through an open manhole. Gas probably leaked from the hose just inside the manhole and drifted beneath the roof segment where it was ignited by a cutting torch.

[oxyacetylene cutting equipment, floating roof tank, fire - consequence, sludge, leak, hose failure, maintenance inadequate, decommissioning, hot work]

Lessons

The following recommendations were made:

1. Manholes must be kept clear during repair work (two manholes were blocked with sections of roof awaiting removal, these manholes were therefore not available as a means of egress).
 2. Oxyacetylene hoses must be inspected regularly.
 3. Oxyacetylene hoses must be disconnected from cylinders or removed from a tank during all unattended breaks in the work.
 4. Hoses must be kept off tank floors and should be supported to prevent mechanical damage.
 5. The area around any tank undergoing repair and hot work must be cleaned of oil deposits before work commences.
 6. Gas cylinders must be stored in an orderly manner and full cylinders must be segregated from empty ones.
-

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

When a relief valve opened the vibration shook loose a screwed plug in the body and the leak of hot heavy vapours ignited. This plug served no purpose in the particular service and so was welded in.

[hydrocarbon, safety relief valve, blowout, fire - consequence, installation inadequate, design inadequate]

Lessons

Equipment or features which are not required for the start-up, shutdown or operation of a unit should be eliminated.

When relief valves lift they can cause serious vibration. The equipment connected to them should be designed to withstand this.

Oversized or incorrectly installed relief valves can cause excessive vibration. Sizing and design of the inlet piping should be checked carefully.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An extensive fire occurred on the LPG recovery installation of a large refinery. It was caused by the ignition of a vapour cloud which had resulted from the escape of liquid butane during the draining of a caustic solution from a salt filter after a hydrogen sulphide scrubber vessel. A number of lines in the fire zone subsequently ruptured providing additional fuel. The successful application of fire fighting techniques prevented the fire from spreading and damage was limited to an area of 20 m by 20 m. the fire was brought under control within 50 minutes and final extinguishment 1 hour later. The cost of repair was \$1.5 million (1981). The butane salt filter drum was 8.1 m³ in volume and contained liquid butane at 17 bar and ambient temperature. The drainage system from the base of the salt filter consisted of a 2 inch drain line containing two valves, a quick shut-off plug valve nearer to the drum and a throttling gate valve. The operator decided to drain the system by opening first the plug valve by turning it in an anti-clockwise direction and then the gate valve with a pipewrench as it was very stiff. No liquid came out and he assumed that it was blocked. He decided to isolate the system by first closing the plug valve. When he did this the drain line started to spray first caustic and then butane liquid. He jumped back and lost his pipewrench but tried to isolate the release by shutting the gate valve by hand without success. An intense fire developed about 50 metres high and the unit was shutdown. The fire also caused the rupture by expansion of the flare line 72 metres from the fire and a fuel gas producer line, both did not ignite but hydrogen sulphide was detected in the area. It was estimated that 25 tonnes of propane and 18 tonnes of butane had burnt. The investigation found that the plug valve on the drain line of the caustic butane salt filter drum had been incorrectly assembled. The plug valve had its gland stop knocks, which limit the turning of the plug from fully open to fully shut, had been reassembled in such a way that turning the plug in a clockwise direction would open the valve instead of closing it and vice versa. Thus the operator actually closed the plug valve then opened the gate valve and therefore got no flow. He then intended to close the plug valve and actually opened thus getting a flow of caustic and butane. [butane, propane, normal operations, filter, fire - consequence, valve failure, maintenance inadequate]

Lessons

1. The plug valve was incorrectly re-assembled.
 2. The system was modified.
 3. Plug valves were provided with the same standardised method of open/closed indication.
-

122811981

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An explosion occurred in a crude distiller furnace when after a spurious trip both fuel gas and liquid butane fires were lost and attempts were made to restart on liquid butane fuel.

Moreover, since the furnace ignitors did not work, a self-made torch was used for lighting the burners.

Although it is not thought to have directly contributed to the explosion, in the event, it did significantly increase the risk of personal injury by necessitating the presence of an operator under the furnace during the lighting procedure.

[design or procedure error, safety procedures inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred when a group of furnaces tripped due to power failure. The explosion occurred in the hydrodesulphurizer furnace when the hydrotreater furnace was restarted. Both furnaces shared common flue gas ducting.

An investigation into the incident found that the hydrodesulphurizer furnace had not been closed and was later established that the burner cocks were passing.

As a result, gas continued to enter the furnace and when the burner of the hydrotreater furnace was lit the flame ignited and built-up gas in the common flue gas ducting and exploded back into the hydrodesulphurizer furnace, which had not been gas tested.

[power supply failure, design or procedure error, safety procedures inadequate]

Lessons

This incident stresses the importance of regular checks on safeguarding systems and closing of all burner cocks after a trip.

122741981

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

An explosion followed by a fire occurred at the convection bank of a crude distiller furnace after a sudden change from an excess fuel to an excess air condition.

The explosive gas mixture originated from too drastic control changes by the panel operator and a misoperation of the manually controlled air dampener by the outside operator. This dampener was closed at the time, it should have been opened further, and was subsequently opened fully when the mistake was noticed.

[operator error, fire - consequence]

Lessons

A clear marking of the "open" and "close" position of the air dampener might have prevented the error.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

Corrosion caused leaks in crude unit overhead fin fan cooler tubes at similar locations on two occasions. The leaks did not ignite. Investigation indicated that the leaks were at the point where water started to condense and where the liquid corrosion inhibitor might not reach due to the inlet header layout. [naphtha, fin fan cooler, blowout, design inadequate, corrosion, safety procedures inadequate]

Lessons

The corrosion inhibitor was liquid at the air cooler inlet temperature. As the inlet headers to the multiple bundles were not symmetrical the inhibitor was maldistributed. Where the water first condensed it was very sour and where there was a lack of corrosion inhibitor corrosion was rapid.

The inlet headers were modified to be symmetrical, a spray nozzle was fitted to the corrosion inhibitor injection point and tubes at the water condensation point were inspected for corrosion at shutdowns.

No further failures have occurred. However, the modifications should have been made after the first failure.

Source : ICHEME

Location : , SPAIN

Injured : 0 Dead : 0

Abstract

A fire at a petrochemical polyethylene plant involving a reactor and ethylene. Source of ignition was static.

[fire - consequence, operator error, reactors and reaction equipment]

Lessons

[None Reported]

2095 25 November 1980

Source : RAILROAD/HIGHWAY ACCIDENT REPORT FREIGHT TRAIN AND TRACTOR/CARGO TANK SEMITRAILER COLLISION AND FIRE, NATIONAL TRANSPORTATION SAFETY BOARD REPORT NUMBER NTSB-RHR-81-1, 1981; HAZARDOUS MATERIALS SPILL MAPS GASOLINE RELEASE FOLLOWING FREIGHT TRAIN COLLISION WITH SEMI-TRAILER, NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, REPORT NUMBER NTSB-HZM-81-2, 1981.

Location : Kenner; Louisiana, USA

Injured : 6 **Dead :** 7

Abstract

A road transportation incident. Gasoline leak following freight train collision with road tanker. Spill. Fatality. The probable cause of this accident was the failure of the road tanker driver to obey the activated warning devices and his attempt to drive the truck across the railroad/highway grade crossing ahead of the freight train.

[fire - consequence, operator error]

Lessons

[None Reported]

2092 24 November 1980

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, REPORT NUMBER NTSB-MAR-81-12, 1981.

Location : Lower Mississippi River; Venice; Louisiana, USA

Injured : 0 **Dead** : 3

Abstract

A marine transportation incident. Chemical marine tanker and supply vessel collided causing the vessel to capsize and considerable damage to the tanker. No spillage was reported from the tanker. Fatality.

[collision, operator error]

Lessons

[None Reported]

Source : ICHEME

Location : , BELGIUM

Injured : 0 Dead : 1

Abstract

An operative engaged in road marking duties on a chemicals plant was killed when a reversing lorry ran over him.

The lorry (operated by a major transport contractor) had been admitted to the plant and issued with all the appropriate documentation and safety rules for the site. The driver collected his load and, because the loading area was quite congested with other waiting vehicles, decided to reverse 150 metres towards the exit rather than making a U-turn. He saw the operative (working in the roadway behind the lorry) in his rear view mirror, but apparently assumed that the man would move out of his way. Shortly afterwards he ran over the operative and killed him.

The operative (who was well-trained and experienced) had set out to do the road marking job equipped with various warning signs. However he had apparently started work without erecting these. Visibility at the time was good, and noise levels low (52dbA).

[road transportation, fatality, driver error, safety procedures inadequate]

Lessons

Three main areas of improvement were recommended:

- Improve the safety attitude of drivers and the standards which they apply by improving instructions and guidelines, and by exercising stronger control over traffic movements.
 - decreasing congestion of the loading area
 - ensuring that areas where road works are carried out are always properly signed.
-

Source : ICHEME

Location : South Charleston, USA

Injured : 0 Dead : 0

Abstract

This incident involved the temporary loss of control of temperature of a flexible polyols reactor. The incident was brought under control manually without damage.

Propylene oxide was being charged into the reactor. The oxide flow meter reading was observed to fall to zero and temperature rose to over 150 degrees C. ESD shut off feeds to the reactor but no audible alarm occurred. The reactor cooling water auto controller was in 'local-auto' mode necessitating action by the operator to increase cooling water flow to bring the temperature under control. Cooling water was maintained after ESD until the reactor cooled down. No overpressure occurred.

The temperature excursion was initiated by construction workers incorrectly switching off power to the oxide feed controller which caused the inflow to fall to zero.

The severity of the temperature excursion was increased by the cooling water flow controller having a fault which prevented remote auto control which would have given more rapid response to the demand for more cooling water.

[reactors and reaction equipment, alarm failure, high temperature, charging reactor, contractor error]

Lessons

1. No protection was provided to prevent inadvertent isolation of power to critical oxide feed controller, modification proposed to guard the switch.
 2. Construction workers were unaware of the consequences of their actions, the workers would be briefed to ensure lessons learned.
 3. There was a design weakness in cooling water control system, modification proposed to control system to give full cooling water supply in the event of over temperature in the reactor.
 4. Previous failure of the oxide feed meter was not analysed for the potential of this incident.
-

2069 21 October 1980

Source : 100 LARGEST LOSSES, 9TH EDITION, MARSH & MCLENNAN PROTECTION CONSULTANTS, 1986.; NEWSPAPER CUTTINGS.

Location : Newcastle; Delaware, USA

Injured : 0 Dead : 5

Abstract

Improper maintenance procedures during cleaning of a plugged recycle cooling line on a polypropylene reactor led to the release of hydrocarbons and polymer. Instead of removing only the motor operator of a 4 inch valve, the valve itself was removed. A vapour cloud of 250 ft by 450 ft was ignited 2 minutes later. The violent explosion broke flammable liquid lines through the three process units and the fire protection risers disrupting all fire water. Fatality.
[spill, reactors and reaction equipment, maintenance procedure error]

Lessons

[None Reported]

2053 09 September 1980

Source : ICHEME

Location : , CANADA

Injured : 0 Dead : 0

Abstract

Fire at a refinery utilities plant. Source of ignition was electrical.

[fire - consequence, refining, transformer, operator error]

Lessons

[None Reported]

Source : ICHEME

Location : , USA

Injured : 1 Dead : 0

Abstract

A near miss incident involving an internal floating roof tank.

A gasoline blend tank was taken out of service for repair of a sunken, pontoon-type aluminum internal floating roof. Inspection revealed massive failure of the roof, due to caustic corrosion attack. Many pontoons were corroded through, but some appeared intact. Three contractor's employees inside the tank began removing the damaged roof using shovels to rip the sheet metal from the support ribs. A fire occurred inside the tank, apparently due to liquid leaking from a pontoon and igniting when a shovel struck metal. The employees escaped from the tank, one sustaining minor injury. The fire was contained within the tank and caused minimal damage. The foreman had smelled gasoline vapours several minutes before the fire occurred, but did not shut the job down.

[mechanical spark, maintenance procedure error, fire - consequence, corrosion, storage, shoval, injury]

Lessons

Conclusions:

1. The contractor supervisor did not terminate activity when hydrocarbon vapours were suspected to be in the tank.
2. The apparent source of ignition was a steel shovel creating a spark which ignited the vapours.
3. No effort was made to inspect all of the pontoons for possible containment of hydrocarbons. One or more pontoons contained gasoline. Provision must be made to remove all the hydrocarbon from within a tank before work can be done safely.

Recommendations:

1. To formulate a comprehensive set of procedures to deal with maintenance in a tank with a pontoon-type roof.
 2. In the interim, until procedures are finalized, to remove all pontoons from a tank by unbolting them, one at a time, and checking for containment of hydrocarbons. If a pontoon contains hydrocarbons, it will be removed from the tank before further work is started.
-

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

During plant maintenance a blowdown drum on an ethylene plant was being replaced and pipework in the vicinity had to be removed. All but one 3 inch pipe had been cut without mishap, but the last pipe was cut into whilst it still contained propylene under pressure. The fitters were cold cutting the pipe using a saw, and noticed an escape of gas. They telephoned the senior operator, who arrived on the scene and identified the gas as propylene by its smell. All work was stopped, and the line isolated and vented.

The investigation revealed that the fitters had requested a permit to cut the pipe, and this had been issued. Unfortunately the issuer of the permit had misunderstood which line he was being asked to clear for cutting, because the drawings and preparation for the job were faulty.

[maintenance, line break, preparation for maintenance, hand tools, gas / vapour release, faulty instructions]

Lessons

The inquiry concluded that insufficient care had been taken in the production of the method statement for the job. In particular, the author of the method statement had omitted all mention of the line in question, despite having inspected the site prior to preparing the statement. The plant superintendent realised what had happened, but did not think the situation required urgent action (because he thought the job had not progressed as far as it actually had), so he did not flag the problem in the control room instructions.

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A section of pipeline burst from its connection in the 450 psig compressed air system. The investigation showed that there had been an oil vapour and air explosion in the pipework following ignition probably by incandescent carbon. This was caused by a combination of poor maintenance, design deficiencies in integrating four compressors and the use of an oil subsequently shown not to be the best suited to the operating conditions.
[air system failure, maintenance inadequate, design inadequate]

Lessons

Recommendations included:

1. The redesigning of the pipework system to the manufacturer's recommendations
 2. The establishment of divisional piping standards
 3. The return to scheduled maintenance of major plant items
 4. A review of safety procedures
 5. The use of an oil suited to the high air pressures involved.
-

2015 17 May 1980

Source : ICHEME

Location : , JAPAN

Injured : 0 Dead : 0

Abstract

Fire at a refinery utilities plant. Source of ignition was electric arcing involving an electrical cable. Cause: operator error.

[fire - consequence, refining]

Lessons

[None Reported]

Source : ICHEME

Location : , USA

Injured : 0 Dead : 0

Abstract

Pressure surges caused fires in two crude units. Valves in crude feed systems failed closed and fluid flow was almost instantaneously stopped. Surge pressures were then generated which exceeded the design pressures of the equipment. The weakest equipment in each system failed and fires resulted. The valve failures, surge pressures were calculated to have exceeded equipment design pressures by 50 to 100 percent. The magnitude of the surge pressure that can result is highly dependant upon the speed of flow interruption and the kinetic energy of the system.
[fire - consequence, design inadequate]

Lessons

[None Reported]

Source : ICHEME**Location :** , BELGIUM**Injured :** 1 **Dead :** 0**Abstract**

During a routine test involving the use of an Instron Capillary Rheometer to measure extrudability of polystyrene, the technician started the test by carrying out the cleaning procedure. Crystal polystyrene was introduced into the barrel of the rheometer, then the piston and piston rod were guided by hand into the barrel, the barrel heated to 230 degrees C and a portion of the polystyrene pushed out of the capillary nozzle at the other end by the power driven piston rod. The technician then lowered the temperature to 200 degrees C to prepare for testing - an operation basically a continuation of the cleaning process. The test was started with the rod and piston being driven at a speed of three inches per minute. Approximately half way down the barrel the machine started to make a noise and the load gauge increased rapidly. As the operator leaned forward to switch the machine off the piston rod shattered and the technician was struck by flying fragments receiving minor lacerations to the right cheek and contusions to forehead. Fragments of the shaft travelled up to three to four metres. Following the failure the broken piston was replaced by a new piston and the polystyrene remaining in the barrel was extruded out with no problems thereby eliminating the possibility of blockage of the capillary die. It was found that piston rods had snapped before on at least four occasions but always clean with no fragments and usually early in the test as the piston entered the top of the barrel. These failures were attributed to initial misalignment of the shaft by the technician. In this case initial misalignment could not have been the cause and the failure was attributed to the piston "binding" in the barrel.

[laboratory work, testing, material of construction failure, operator error, plant / property / equipment]

Lessons

Following the accident it was decided to:

1. Wear a full face shield.
2. Do not leave the rheometer running unattended.
3. Follow the instructions carefully.
4. Press the stop button immediately if you hear a noise of the motor labouring or if the indicated load reaches 4,000 lb.

2005 16 April 1980

Source : PIPELINE ACCIDENT REPORT WILLIAMS PIPELINE COMPANY GASOLINE EXPLOSION AND FIRE, NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, REPORT NUMBER NTSB-PAR-81-3, 1981.

Location : Roseville; Minnesota, USA

Injured : 3 **Dead :** 1

Abstract

An explosion and fire occurred when gasoline sprayed from the fractured cast iron base of a booster pump at 72 psig and ignited on an arcing switch in the mainline pump control room. About 147000 gallons of petroleum products burned. The newly installed pump had not been hydrostatically tested as a complete facility prior to incident. The switch was 50 ft from pump and was not explosion proof. Fatality.

[fire - consequence, pipeline, testing inadequate]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

Traffolyte labels were being fitted to the covers of a miniature circuit breaker that housed busbars (440 volts and 160 amps). The equipment was "live". A prior check, as to the clearance between the circuit breaker cover and the "live" equipment had been made but, nevertheless, the screw holes for the labels were being drilled through the covers with the busbars "live". The drill bit contacted the busbar causing an electrical fuse failure and bang/flash. Nobody was hurt.

[maintenance, safety procedures inadequate, damage to equipment]

Lessons

The method employed was inherently unsafe. Several alternative methods existed, eg. use of adhesives to fix the label to the cover or isolating the electric power before drilling. The incident might easily have resulted in a fatality had other circumstances e.g. earthing not been adequate.

11411March 1980

Source : LLOYDS LIST, 10 SEP, 1983.

Location : , NORTH SEA

Injured : - Dead : 123

Abstract

A self propelled semi submersible offshore accompanied platform capsized in the North Sea killing 123 people on board.

The capsizing was caused by failure of one of the 5 legs. The cause of the failure determined by the official enquiry was poor design and construction. Cracks were found in welds on the bracing structure.

Alternative enquiries maintained that:

1. The top side deck was overloaded accommodation on the deck side affecting its balance.
2. Alarm to indicate hatches on the legs being left open were jammed so a fire hose could be left passing through a hatch propped open by a pipe.
3. An explosion had caused damage to the platform's structure.
4. Earlier collisions with ships had caused cracks in the platform's structure.
5. The platform was righted three years later to recover 23 bodies still on board and later towed to deep water and sunk.

[capsizing of platform, mechanical equipment failure, design inadequate, exploration, structural failure, fatality]

Lessons

[None Reported]

1980 06 February 1980

Source : ICHEME

Location : , FRANCE

Injured : 0 Dead : 0

Abstract

An explosion occurred involving a boiler at a refinery utilities plant. Source of ignition was hot surface.
[operator error, refining]

Lessons

[None Reported]

1974 30 January 1980

Source : PIPELINE ACCIDENT REPORT, NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, NTSB PAR 80-6.

Location : Sector Cana Of Bayamon, PUERTO RICO

Injured : 0 **Dead :** 1

Abstract

An 8 inch diameter pipeline containing refined petroleum products was struck and ruptured by a bulldozer during maintenance work on a nearby waterline. Gasoline from the rupture sprayed downhill and ran into a small creek. One and a half hours later the vapours ignited and damaged 25 houses. The cause was the damage by the bulldozer whose operator was unaware of the depth and location of the pipeline. Contributing was the lack of markers. Fatality.
[excavation damage, operator error, vapour cloud explosion, bulldozer/JCB/digger]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

A fire occurred in a transfer/mixer unit in use for the production of synthetic resins. It spread to adjacent equipment causing fairly extensive damage. Nobody was hurt. The original fire occurred because foreign metallic material entered the mixer via damaged screens at hopper bases. This material generated friction heat and a temperature sufficient to promote a vigorous reaction between the chemicals in the mixer and a conflagration due to the presence of fine material. The particular mix of chemicals present arose due to an operational error.

[fire - consequence, contamination, mixing, material transfer, operator error, damage to equipment]

Lessons

1. Prevent the ingress of foreign bodies into reaction vessels.
 2. Fit fire breaks into multi-stage equipment where practical.
 3. Disseminate all available information re chemical (and other) effects of incorrect operations.
 4. Provide systems which make it easier to carry out procedures correctly.
-

Source : ICHEME

Location : Wales, UK

Injured : 1 Dead : 0

Abstract

A painter was de-scaling a tank which he had accessed from scaffolding. He fell through untied boards on the scaffold and injured his back. How far he fell is not stated, but he injured his back and needed hospital examination before returning to work. Scaffolding erection was not complete at the time of the accident, though it had been in use for about five days before the accident. No formal request for erection of scaffolding had been raised. The scaffold had been (partially) erected under the terms of a request raised about three weeks before the accident for examination of corrosion underneath lagging.

[maintenance, scaffolding, fall, safety procedures inadequate, injury]

Lessons

Procedure, and supervisory, shortcomings were the main contributory causes of the accident.

1. Contributors were not fully familiar with maintenance procedures.

2. Formal

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

A welder was working within a road tanker. Air for breathing was supplied by a fan. For the noon break the man switched off the fan and left his welding gun with argon supply inside the tanker. When he came back to resume work he fell unconscious almost immediately, but fortunately he was rescued.

[maintenance, contamination, near miss, atmosphere not tested, entry into confined space, injury]

Lessons

[None Reported]

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

A heavily fouled heat exchanger tube bundle was being cleaned by a specialist contractor using a water/sand mixture at a jet pressure of 400 atmospheres. The spray gun was held under the right arm and guided with the left hand. The discharge valve lever was operated by the right hand. The contractor got his protective glove caught between the valve lever and the top of the gun when he released it. At that moment with the jet not shut off, the contractor was forced by the counter pressure to turn through an angle of 180 degrees and stumbled; the jet hit him on the upper part of the right thigh. The contractor was seriously injured and remained off work for many months.

The area was surrounded with sheet steel screens which prevented the jet from hitting other personnel.

[cleaning, operator error, near miss, injury]

Lessons

High pressure jetting is potentially very dangerous. Facilities should be safe by design and operators should not do this type of work alone.

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Fitters working on a flare line system wearing air-line breathing apparatus reported that insufficient air was reaching their masks.

The breathing air supply was taken from an octafiner instrument air system and investigations showed that the air supply feeding the masks had been accidentally switched off.

Isolation and venting of instrument air was carried out from the control room and the wrong lever was inadvertently operated when it was decided to carry out instrument maintenance work on another unit thereby cutting off the instrument air supply to the octafiner.

[operator error]

Lessons

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

Two operators were using torches to light the pilot on the crude and heaters which were being purged with steam.

Kerosene was drawn from a sample point into a pot and two torches were soaked and lighted.

After the pilots were lit, the torches were extinguished with a steam hose and dumped into the pot which immediately ignited.

While attempting to remove the torches, the pot fell over and the operator's trouser leg caught fire.

Other operators extinguished the clothing fire with the aid of a fire blanket. Fortunately the operator was not badly burned.

[fire - consequence, competency lacking, burns]

Lessons

Do not use torches for lighting pilots and burners. Use a portable electrical ignitor. Where pilot burners are not fitted, the same ignitor can be used to directly light main gas burners. Heavy fuel oil normally requires more ignition energy than is provided by this type of ignitor and so a portable propane flame torch can be used.

Dry powder extinguishers provide the most effective means of dealing with a person whose clothing is on fire.

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

A man who worked at a scrap yard received serious hand injuries when a 45 gallon metal drum exploded. He was cutting the drum with a welding torch when the explosion occurred and the force of the blast sent the drum lid flying 20 yards through the air. Eighteen years ago on the same premises a man had been killed in a similar accident when he was using a torch on a petrol container.

[safety procedures inadequate, gasoline, injury]

Lessons

All equipment sent for scrap should be free from flammable and toxic material. If it is not reasonably practicable to certify that the equipment to be removed from site is free from flammable, corrosive and toxic substances, then prior agreement and precautions must be agreed with the recipient and the donor site should be satisfied with the recipient's system of work to guard against similar incidents.

101821980

Source : ICHEME

Location : , UK

Injured : 0 Dead : 0

Abstract

A failure occurred on a manual hydraulic lift truck whilst the unit was being used to lift a piece of steel approximately 1 cwt. The fork failed and the steel fell. Examination of the truck showed that the weight carried by the fork is transferred to the frame by means of a steel angle cap welded onto the top of the fork. These welds had failed and it was noted that only three out of four sides had been welded and that the degree of weld penetration was 50% or less.
[lifting equipment, damage to equipment, design fault, forklift truck]

Lessons

The failure of the fork was considered to be the result of unsatisfactory construction and possibly design. Similar trucks with the same methods of construction were withdrawn from service pending consultation with the manufacturer. Repairs will include the grinding out of all existing welds and rewelding to an approved procedure to include the fourth side.

Source : ICHEME

Location : ,

Injured : 3 Dead : 0

Abstract

Two maintenance contractors and a process operator were gassed during a blanking-off job on a acid gas knock out drum associated with a sulphur unit. The process operator lost consciousness but was revived by the refinery's firemen.

A number of factors contributed to the accident but the prime cause was a breakdown in accepted methods of safe working where there was a potential risk of exposure to H₂S (hydrogen sulphide) i.e. breathing apparatus was not worn, supervision and control of the job were inadequate and the permit-to-work arrangement was loose. In addition, the design of the system prevented positive isolation so that there was a strong possibility that loss of containment would occur.

After investigation the following was found:

1. Inadequate supervision in relation to the potential risk of exposure to H₂S, the work was being supervised by an inexperienced operator.
2. Inadequate isolation for minimising the possibility of H₂S leakage from the K0 drum. An isolation valve which can be locked shut should be installed between the check valve and the K0 drum.
3. Failure to wear breathing apparatus.
4. Failure to recognise the limitations of canister masks which provide inadequate respiratory protection in the event of exposure to high concentrations of H₂S.
5. Inadequate permit-to-work arrangement. A cold work permit issued for any maintenance work where respiratory protection is required should be given special status by limiting permit signatories e.g. to those persons who would normally sign hot work and entry permits.

[safety procedures inadequate, permit to work system inadequate, slip plate insertion/removal, isolation inadequate, blind/spade/slip plate]

Lessons

A full set of precautions must always be in place when work is carried out on any systems involving toxic or inert gases.

1. The time factor is as important with respect to resuscitation that consideration should be given to placing resuscitation equipment in control rooms of plants handling toxic materials.
2. It can then be administered on the spot by operators trained in its use. The resuscitation equipment and training of operators in its use should remain the responsibility of local qualified medical staff. The presence of such equipment on a plant must not be allowed to diminish the importance of existing emergency facilities and the need to summon medical staff immediately.

Source : ICHEME

Location : ,

Injured : 8 Dead : 0

Abstract

The incident occurred during commissioning operations on the catalytic cracker unit. Eight men were treated in the refinery medical centre following the inhalation of gas. The incident occurred whilst the spade isolating the regenerator and reactor systems from the main fractionator was being removed. Both systems were under a steam blanket and work had progressed to the point where the flanges had been jacked open and the spade removed.

Three of the men engaged on the job were affected by gas, the fourth apparently suffered no ill effects. Breathing apparatus were not being worn (and never had been) for this job, which had been carried out without incident over the past 28 years.

The other four men affected were those who went to the scene on hearing cries for assistance.

The degree of exposure varied; two were returned to work, six were sent home, and of these, one subsequently lost three work days as a result of the incident.

[safety procedures inadequate, gas / vapour release, slip plate insertion/removal, blind/spade/slip plate, cracking]

Lessons

1. Breathing apparatus must be worn where there is risk of exposure to a level of nitrogen that could cause oxygen deficiency of the local surrounding atmosphere.
 2. All persons and in particular supervisors must be made aware of the risks associated with nitrogen to ensure that suitable precautionary measures are taken when similar work is undertaken.
-

Source : ICHEME

Location : ,

Injured : 1 Dead : 0

Abstract

A shift fitter collapsed whilst installing a valve to the hydrogen make-up line on a distillate hydrotreater unit. The line was being purged with nitrogen at the time to prevent ingress of air into the pipework system. The fitter was taken to hospital but later released, returning to his work on the evening shift.

A leak developed on the hydrogen make-up line between a control valve and the downstream block valve, the valve was subsequently found to be passing when it was tightly shut off.

The hydrogen supply was isolated and the pipework purged with nitrogen ready for the removal and replacement of the leaking pipe and passing valve.

Operations issued a cold work permit for the job which was to be carried out with the system purged with 5 psig nitrogen. No consideration was given to the danger of escaping nitrogen or the need to wear respiratory protection for the job although the permit stipulated that the line was to be purged with inert gas.

After removal of the pipe and valve, the new valve was lifted into position with the help of colleagues to allow the fitter to locate the first bolt. The flange is located 1.44 m. above ground level and the fitter's head was very close to, and upwind of, the flange through which nitrogen was escaping. As soon as the bolt was tightened, the fitter withdrew and collapsed. He was pulled clear by his work mates and within 2 to 3 minutes regained consciousness and was given oxygen from a mask which was obtained from the unit control room. The ambulance was called and the casualty was transferred to hospital.

All persons present at the time of the incident were interviewed but none of them appreciated the danger of nitrogen (atmosphere in the immediate vicinity of the escaping nitrogen could be deficient of oxygen) and it appeared that other jobs involving nitrogen purging in open air situations were carried out without breathing apparatus.

[safety procedures inadequate]

Lessons

1. Breathing apparatus must be worn where there is risk of exposure to a level of nitrogen that could cause oxygen deficiency of the local surrounding atmosphere.

2. All persons and in particular supervisors must be made aware of the risks associated with nitrogen to ensure that suitable precautionary measures are taken when similar work is undertaken.

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 27 **Dead :** 0

Abstract

Leakage of hexane from a flap valve of the extractor during plant start-up occurred. An inexperienced worker had seen the overpressure flap valve rise several times but did not inform anybody. Due to the leakage, the temperature in the extractor building rose and the sprinkler system came into operation. A very high concentration of hexane in the building developed. The decision was taken to disconnect the power supply of the area involved. A power plant engineer rejected the idea of stopping the loaded transformers due to the inherent risk of sparks but, for unknown reasons, disconnected a third unloaded transformer. It is believed that this caused the ignition of hexane vapours and the explosion.

[high temperature, operator error, injury]

Lessons

[None Reported]

Source : ICHEME

Location : , UK

Injured : 1 **Dead :** 0

Abstract

During a shutdown a line which had not been purged to clear it of liquid was opened up at a low point. The liquid fell onto a high pressure steam line and this ignited it.

[hydrocarbon, shutdown, flange, fire - consequence, draining of line insufficient, safety procedures inadequate]

Lessons

Procedures for clearing lines before shutdown maintenance work starts must be carefully planned and executed to ensure that no flammable or toxic liquid remains.

As a further precaution where there is a source of ignition close to the flange to be broken, a portable tundish and hose should be used to divert any liquid away from this source of ignition.

Source : ICHEME

Location : ,

Injured : 0 Dead : 0

Abstract

Thirteen boilers were in operation in the Power Station leaving only the two new boilers out of commission.

A fitter (of 20 years experience) with an excellent work record, and an apprentice, were engaged on the replacement of a steam inlet control valve on one of the fuel oil heaters. Both men had carried out similar work on two other boilers two days previously.

A cold permit-to-work had been issued for the job and the steam supply had been isolated in accordance with permit conditions. The fuel oil was sufficiently hot for the steam heating to be shut off during the period of this work.

A capillary tube from the steam valve extends to a bulb contained in the steel thermowell pocket which is screwed into a socket on the outlet bend of the fuel oil heaters. While the apprentice was removing the remaining bolts in the steam control valve at ground level, the fitter was working on top of the fuel oil heater removing the capillary tube/bulb arrangement from the fuel line. The fitter eased off the clamping nut on the union and then unscrewed the union to enable him to remove the bulb. On removing the union he discovered that the capillary tube was fractured at the neck of the bulb. The bulb was still in the pocket with insufficient tube protruding on which to grip firmly to extract the bulb. He then proceeded to remove the thermowell pocket without apparently considering the possible consequences. While the thermowell was being un-screwed, there was no sign of oil until suddenly the pocket blew out of the coupling on the line. The temperature and pressure of the fuel oil was about 200 degrees F and 150 psig respectively, and was discharged from the 1.25 inch diameter nozzle directly on to the EHP steam header. The fuel oil ignited immediately and a serious fire resulted in the area. Both men were slightly shocked but uninjured. It was estimated that fuel oil was discharged from the nozzle at an average rate of approximately 350 gpm, resulting in about 5,000 gallons being sprayed over the fire area in the initial 15 minutes.

Immediate investigation of the scene by power station staff revealed a mass of flames spread across 30 yards of the boiler house and rising to a height of approximately 50 feet above the boiler house roof.

The three boilers immediately involved in the fire were tripped manually from the control room and the fire service was called. Power Station personnel immediately commenced isolation of the three boilers from the battery limits. Isolating valves for both the low flash fuel and fuel oil were not readily accessible as they were sited approximately 15 feet above grade on the overhead piperack.

There was no proper access to the valves and it was necessary to climb up the pipe support steelwork and crawl along the pipelines to gain access to the valves. The incident occurred during normal working hours with additional power station staff available to carry out the emergency tasks.

Considerable concern was felt by the Refinery Fire Service in using water in an area containing many high temperature and pressure steam lines. However, it was essential that some action was taken to prevent escalation of the fire and it was decided to use water in a spray form for cooling and foam to counter the ground oil fire. The fire was intense and only slowly being controlled until the fuel supply could be shut-off at the battery limit, it was then fairly quickly extinguished.

[fire - consequence, damage to equipment, operator error, maintenance]

Lessons

Experience alone cannot prevent human errors from occurring. Wherever possible equipment must be SAFE BY DESIGN.
