Lessons Learned Database
Individual Incident Summary Report

IChemE
Safety & Loss Prevention
Special Interest Group

Incident Title	**Raffinate Splitter Liquid Overfill**		
Incident Type	Explosion		
Date	23rd March 2005		
Country	USA		
Location	Texas City (now Galveston Bay), TX		
Fatalities	**Injuries**	**Cost**	
15	180	US$ 1.5 bn (2007) – Ref. 2	

Incident Description

Credit: US Chemical Safety Board

A Raffinate Splitter was inadvertently overfilled with liquid during startup. As the splitter warmed up, the pressure rose and liquid puked into the overhead line. The pressure safety valves (PSVs) were located in the overhead line approximately 45 m (148 ft) below the top of the tower. The overfill created enough static head to cause the PSVs to lift, discharging a large quantity of light hydrocarbons to the unit blowdown drum which was connected to an atmospheric vent stack (not equipped with a flare). Most of the liquid released flowed to a closed sewer but some puked like a geyser from the top of the stack. The resulting vapour cloud found an ignition source and exploded. Fifteen people in or near temporary turnaround office trailers located close to the blowdown stack were killed and a further 180 were injured. A shelter-in-place order was issued requiring some 43,000 people to remain indoors.

Incident Analysis

Basic cause was light naphtha puking from an atmospheric blowdown stack, forming a vapour cloud which found an ignition source (probably idling diesel vehicle engine) and exploded.

Critical factors included: 1) Displacer-type level indicator (level appeared to drop as base temperature rose), 2) Faulty level alarms, 3) Failure to institute rundown before heatup, 4) Tower de-rated due to corrosion under insulation (lower PSV set pressure), 5) Poor trailer (temporary turnaround office) siting.

Root causes included: 1) Inadequate design (blowdown stack not connected to flare), 2) Inadequate hazard identification (reducing the PSV set pressure shrinks the safe operating envelope and increases the risk of liquid discharge to the blowdown vent stack), 3) Inadequate maintenance (level alarms), 4) Failure to follow and enforce pre-startup safety review (PSSR) procedure, 5) Failure to follow unit startup procedure (establish rundown before commencing heatup), 6) Poor communication (shift handover), 7) Inadequate operator training (troubleshooting), 8) Inadequate control of work (trailer siting), 9) Failure to learn (previous incidents).

Lessons Learned

1) Light hydrocarbons heavier than air should not be routed to atmospheric blowdown stacks, 2) Instruments and alarms should be tested and verified before startup, 3) Operating procedures should be kept up to date and strictly enforced (all deviations requiring MoC review), 4) Occupied portable buildings should be sited outside well-defined exclusion zones, 5) Vehicles should not enter potentially hazardous areas and should not be left running unattended, 6) Non-essential personnel should not be permitted on or near operating plant (especially during startup), 7) Leading and lagging process safety indicators should be used to drive performance improvement.

More Information

1) “The Report of the BP US Refineries Independent Safety Review Panel”, J.A. Baker, January 2007.
2) “Investigation Report - Refinery Explosion and Fire”, US Chemical Safety and Hazard Investigation Board, Report No. 2005-04-I-TX (2007).
3) “Failure to Learn - the BP Texas City Refinery Disaster”, Andrew Hopkins, CCH Australia Ltd., ISBN 978 1 921322 44 0 (2012).
4) “Management of Hazards Associated with Location of Process Plant Portable Buildings”, API RP-753, American Petroleum Institute (2007).
5) “Process Safety Indicators for the Refining and Petrochemical Industries”, API RP-754, American Petroleum Institute (2016).

Industry Sector	Process Type	Incident Type
Oil & Gas	Naphtha Splitter	Explosion
Equipment Category	**Equipment Class**	**Equipment Type**
Safety & Control	Instruments	Level

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