### Timeline of key events

- **0215:** Operators started to introduce raffinate into splitter tower (which is used to distil & separate gasoline components – the tower was >100’ tall)
  
  A single instrument was available for **liquid level indication** at bottom of tower – with a maximum indicated level 9’ – but operators routinely filled above this during start-ups to avoid possibility of low level causing furnace damage.

- **0309:** Hi level alarm actuated. Hi-hi alarm failed to actuate.
  
  0330: Level indication showed 9’ and feed was stopped by operators (but level was actually at ~13’)

- **0500:** Lead operator in satellite CR for ISOM unit gives briefing to CCR and leaves to go home (early)

- **0600:** New CCR operator arrives (to start his 30th consecutive day doing 12 hour shifts)
  
  Shift log was unclear about level and state of start-up “ISOM: brought in some raff to unit”

- **0715:** Day supervisor arrives (late, so he had missed handover)

- **0951:** Startup resumed – more feed put into already over-filled splitter tower
  
  Auto level control valve left closed because of ‘conflicting instructions’

- **~1000:** Furnace lit to start feed heating

- **1050:** Day supervisor leaves site for family medical emergency – no supervisor in CCR contrary to rules – single operator now running 3 units including ISOM unit
  
  A second operator position had been eliminated in 1999 after BP took over Amoco

- **~1200:** Splitter tower level reaches 98’ (15x normal level) but level instrument says 8.4’ and gradually falling.

  Screen displays did not show flow in and out on same screen, nor calculate total liquid in tower.

- **~1200:** Maintenance contractors left temporary trailers for a lunch to celebrate one month without lost-time injury

- **0309:** Hi level alarm actuated. Hi-hi alarm failed to actuate.
  
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- **~1300:** Contract workers returned from lunch to temporary trailers near blowdown drum

- **1314:** Hot feed causes boiling and level rise so that tower is filled completely and spills into vapour line, causing **pressure relief valves** in vapour line to open. 52000 gallons of liquid thereby vents to **blowdown drum**, where it overflows and drains into a process sewer, setting off control room alarms. High-level alarm in blowdown drum failed to actuate. Geyser of liquid and vapour erupts from vent above blowdown drum. Hot gasoline forms a large vapour cloud, which was ignited by a running truck engine nearby. Explosion and fire ensued, 15 killed, 180 injured. Temporary trailers housing contractors were destroyed in blast.

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**BP Texas City Refinery Fire and Explosion 23rd March 2005**

**Plant state:** Lots of contractors were on site for maintenance projects. Temporary trailers were near hazardous plant, including the isomerisation unit. Isomerisation unit start-up was in progress.

**Timeline of key events**

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1241: Alarm says high pressure at top of tower (due to compression of gases by rising liquid level)

Operators opened manual valve to vent gases into the relief system (which vented unflared gas into atmosphere via a blowdown drum)

Operators also turned off two burners in furnace (thinking this would reduce pressure)

Operators opened valve to allow liquid to go from bottom of tower to storage tanks

This liquid was very hot and flowed through a heat exchanger with liquid entering tower, raising temperature of liquid entering tower by 141 deg F.

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January 2012
BP Texas City Refinery Fire and Explosion 23rd March 2005

Early warnings and precursors to the accident

1. There were multiple safety system deficiencies at Texas City.
2. 23 people had died over 30 years at Texas City.
3. Budget cuts were made without reviewing for effects on process safety (25% cuts at all refineries after BP-Amoco merger)
4. 2002 BP reports: “Infrastructure at Texas City was in compete decline.” “Serious concerns about potential for major site incident.” There were 80 hydrocarbon releases at Texas City in two-year period.
5. 2003 BP audit report: “Current condition of infrastructure and assets is poor at Texas City”. Maintenance spending was limited by “chequebook mentality”.
7. 2004: Texas City refinery had three major accidents – including 3 fatalities and $30m damage – but lowest ever LTA rate.
9. ISOM unit splitter tower high level alarm had been reported as not functioning several times in two years prior to accident – but maintenance work orders were closed without repairs being effected.
10. Feb 2005 internal BP memo: “I truly believe we are on the verge of something bigger happening.”

11. BP was “blind to process safety, focussing on personal safety.”
12. There was a lack of open reporting – a punitive culture.
13. Decentralised management impaired learning from incidents elsewhere.
14. There was a failure to investigate near-misses in previous ISOM start-ups.
15. Lack of modern design for key safety systems (e.g. level instrumentation, blowdown system)
16. Occupied trailers near ISOM unit – this neglected industry siting guidelines – BP’s own Management of Change guidelines were not heeded.
17. Personnel in trailers were not advised of start-up operations.

18. Human factors:
   a) There was serious worker fatigue and no fatigue prevention policy
   b) Inadequate training – training had been down-sized
   c) Lack of procedural adherence
   d) Out-of-date procedures
   e) “No accurate and functional measure of level in tower” led to incorrect decisions
   g) Communication issues in shift handover
19. Lack of robust enforceable external independent auditing
20. Tolerance of serious deviations from safe operating practices
21. Apparent complacency toward serious process safety risks
22. Restructuring following BP-Amoco merger resulted in a significant loss of people, expertise and experience.
23. “All hazardous chemical operations should be required to review the safety impact of major organisational changes.”
**CSB Key Lessons**

1. Track KPIs for monitoring safety performance
2. Maintain adequate resources for safe operation and maintenance
3. Nurture and maintain a proper safety culture
4. Non-essential personnel should be remote from hazardous process areas
5. Equipment and procedures should be kept up-to-date
6. Manage organisational changes to ensure safety is not compromised
7. Analyse and correct the underlying causes of human errors
8. Directors must exercise their duties regarding safety standards

**Key references:**