Lessons Learned Database
Individual Incident Summary Report

IChemE
Safety & Loss Prevention
Special Interest Group

IChemE
Safety & Loss Prevention
Special Interest Group

Incident Title	Gasoline Storage Tank Overfilled
Incident Type	Explosion and Fire
Date	11th December 2005
Country	UK (England)
Location	Buncefield (Hertfordshire)

Fatalities	Injuries	Cost
0	43	£ 894 m (2008) – Ref. 1

Incident Description	
Credit: UK Health & Safety Executive	A gasoline (petrol) tank at an oil storage and distribution terminal was overfilled with gasoline (petrol) which subsequently overflowed into a bund. A large vapour cloud formed and eventually flowed over the bund wall. Multiple explosions occurred and the resulting major fire engulfed 20 large storage tanks. Large clouds of black smoke from the burning fuel spread over southern England and beyond. The fire burned for 5 days, destroying most of the terminal and damaging surrounding homes and business premises. Fortunately, there were no fatalities (probably because the explosion took place in the early hours of a Sunday morning when very few people were on site). However, 43 people suffered minor injuries and approximately 2000 people had to be evacuated from the area. Firewater, foam and fuel product runoff from the site caused pollution of an underlying potable water aquifer.

Incident Analysis	
	Basic cause was a loss of primary containment (LOPC) due to failure of the servo-type level sensor used by the automatic tank gauging system and the digital high level switch used by the automatic high level shutdown system.

Critical factors included: 1) The automatic tank gauging (ATG) system operator interface only had a single display screen, 2) The independent high level switch (IHLS) failed to operate (test arm had not been locked in "operate" position), 3) The incident occurred in cold, still conditions (low-lying vapour cloud, not well-dispersed), 4) Flexible sealant joints between sections of concrete tank bund failed on fire exposure, 5) The site drain and catchment system was only designed for containment of rainwater and minor spills.

Root causes included: 1) Inadequate operating procedures (tank filling), 2) Inadequate monitoring of tank inventories (ATG control system graphics), 3) Inadequate management of change (IHLS replacement and changes to tank bund design during construction), 4) Inadequate maintenance (ATG servo level sensor sticking and IHLS test arm lock criticality not understood), 5) Inadequate maintenance management system (defect logging), 6) Human factors (staff under pressure due to terminal throughput creep reducing ullage and inability to control flow/timing of pipeline receipts), 7) Inadequate design of secondary (bunds) and tertiary (drain/catchment) containment systems, 9) Inadequate emergency planning (major spill and multi-tank fire response). |

Lessons Learned	
	1) Severe vapour cloud explosions can occur in open areas in still (nil-wind) conditions; this may be the dominant risk for liquid fuel storage terminals.
2) Risk assessments should consider potential worst-case scenarios involving multiple tank/bund fires and large volumes of firewater run-off.
3) Bunds should be treated as safety-critical equipment and regularly inspected (and repaired if necessary) to assure their integrity,
4) Tertiary containment (e.g. drainage) should be designed to cope with a large-scale spill so runoff is contained on site and pollution is prevented.

More Information	
	1) "The Buncefield Incident 11 December 2005: Report of the Major Incident Investigation Board Volume 1", HSE Books, 2008, ISBN 978-0-7176-6270-8.
2) "Safety and Environmental Standards for Fuel Storage Sites", Process Safety Leadership Group, HSE Books, 2009, ISBN 978-0-7176-6386-6.
3) "Buncefield: Why Did It Happen", COMAH Competent Authority, 2011, https://www.hse.gov.uk/comah/buncefield/buncefield-report.pdf.
4) "Managing Risk: The Hazards That Can Destroy Your Business", COMAH Strategic Forum, 2017.

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