

Incident Title		Multiple LPG Storage Tank Ruptures			
Incident Type		BLEVE			
Date		19 th November 1984			
Country		Mexico			
Location		San Juan Ixhuatepec, HG			
Fatalities		Injuries		Cost	
542		4,248 (Kletz)		US\$ 29 m* (2001) – Ref. 3	
Incident Description		<p>A DN 200 (8" NS) liquified petroleum gas (LPG) transfer line ruptured at a state owned and operated storage/distribution terminal while being filled from a refinery 400 km (250 miles) away. The leaking LPG formed a vapour cloud which spilled over the bund walls which surrounded the pressurised storage vessels (spheres and bullets) and migrated towards a ground flare. The flame front accelerated back towards the leak source. Several pool fires erupted, causing a series of catastrophic boiling liquid expanding vapour explosions (BLEVEs) which blew many of the vessels off their supports. The first BLEVE occurred 15 minutes after the initial release. Burning LPG liquid rained down on the neighbouring shanty town which had expanded to 130 m (427 ft) from the terminal fence. The official death toll was 542 with 4,248 injured but unofficial estimates were higher (shanty town population unknown). Around 200,000 people had to be evacuated and ~ 10,000 people became homeless.</p>			
 <p>Credit: Sipa/Shutterstock</p>		<p>Incident Analysis</p> <p>Basic cause was a loss of primary containment (LOPC) due to overpressure of an LPG transfer pipe or overfilling of a pressurised storage vessel (exact cause unknown as much of the physical evidence was destroyed by fire).</p> <p>Critical factors included: 1) Defective level instrumentation, 2) Inadequate spacing between LPG storage vessels, 3) Storage vessels were surrounded by 1 m high concrete walls (allowing LPG to accumulate where most harmful), 4) Absence of passive fire protection (e.g. gas detectors, storage vessel and support fireproofing), 5) The firewater system was disabled in the initial blast, 6) Proximity of housing to the terminal perimeter, 7) Arrival of the emergency services was delayed by traffic chaos as panicked residents tried to flee.</p> <p>Root causes included: 1) Inappropriate design (no gradient in bunded area below storage vessels to prevent pooling, inadequate vessel spacing and vulnerable above-ground firewater system), 2) Inadequate safeguards (absence of overfill protection, gas detectors and fireproofing of vessels and supports), 3) Inadequate management of change (relief capacity not raised when LPG fill rate increased), 4) Inadequate maintenance (instrumentation), 5) Inadequate operator training (ESD system initiated too late), 6) Inadequate emergency response planning (emergency vehicle access and evacuation routes), 7) Inadequate land use planning (shanty town too close to terminal).</p>			
Lessons Learned		<p>1) Escalation impact studies should be carried out to inform plant design (e.g. plant layout, equipment spacing, active/passive fire protection, etc).</p> <p>2) LPG bulk storage vessels should be equipped with remote-operated emergency isolation valves (EIVs) to minimise inventory loss in case of pipe rupture. EIV actuators should be designed so that the valves cannot close too quickly and create a pressure surge through hydraulic hammer.</p> <p>3) High hazard installations should have designated emergency access and egress routes available which should be regularly inspected and tested.</p> <p>4) Land use planning regulations specifying minimum separation distances between high hazard facilities and residential buildings should be enforced.</p>			
More Information		<p>1) "Analysis of the LPG Disaster in Mexico City", C.M. Pietersen, TNO, Apeldoorn, Netherlands.</p> <p>2) API Standard 2510: "Design and Construction of LPG Installations", 9th Edition, American Petroleum Institute (2020).</p> <p>3) "The 100 Largest Losses 1972 – 2001", Marsh Property Risk Consulting Practice, 20th Edition (2003). [* First party property damage cost only]</p>			
Industry Sector		Process Type		Incident Type	
Oil & Gas		Liquified Gas Storage		BLEVE	
Equipment Category		Equipment Class		Equipment Type	
Mechanical		Piping		Pipe	