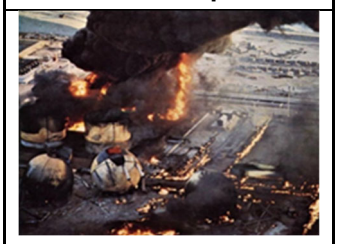
Incident Title	**Propane Storage Sphere Rupture**	
Incident Type	Fire and BLEVE	
Date	4th January 1966	
Country	France	
Location	Feyzin	
Fatalities	**Injuries**	**Cost**
18	84	Unknown

Incident Description



An operator was draining water from a propane storage sphere via a DN 50 (2" NS) vertical drain leg below the sphere. The drain had 2 manual isolation valves in series. Both were opened but, contrary to operating procedure, the lower valve was half-opened first, then the upper valve was opened further. When draining was almost complete, the upper valve was closed, then cracked open again. No flow was observed so the upper valve was opened fully. A blockage (probably ice or hydrate) suddenly cleared, and propane gushed out. The handle fell off the upper valve and could not be reinstated. Attempts to close the lower valve failed as it had frozen in the half-open position. A large vapour cloud formed and drifted to a nearby road where it ignited and flashed back to the sphere causing a fierce fire. Around 1 hour later, a boiling liquid expanding vapour explosion (BLEVE) occurred as the sphere ruptured. Some shrapnel struck the support legs of an adjacent sphere which then collapsed and toppled over. Damaged pipe fittings on the toppled sphere began discharging liquid which further fed the fire and, 45 minutes later, this second sphere ruptured in another BLEVE. Three more spheres collapsed and ruptured but did not explode.

Incident Analysis

Basic cause of first fire was ignition of a vapour cloud formed by accidental release of a large quantity of propane from an open drain. Basic cause of first BLEVE was fire engulfment and overheating of the sphere.

Critical factors included: 1) The lower drain valve was erroneously opened before the upper drain valve (causing Joule-Thomson chilling and ice or hydrate formation), 2) The ground under the sphere was level (allowing pooling of leaked propane in the bund), 3) The firewater pump capacity was insufficient to protect all the spheres, 4) The local fire brigade did not try to cool the burning sphere, mistakenly believing it would be protected by its PSV (they directed their hoses to cool 4 adjacent spheres instead).

Root causes included: 1) Failure to follow operating procedure (drain valve operating sequence), 2) Inadequate storage sphere design (support legs not reinforced), 3) Inadequate drain system design (removable valve handles, open discharge in close proximity to valves), 4) Inadequate overpressure protection (absence of remote depressuring valve), 5) Insufficient active (water spray) and passive (insulation) fire protection, 6) Failure to train local fire brigade on how to deal with this type of incident.

Lessons Learned

1) Sphere support legs should be reinforced (for shrapnel impact protection), 2) Storage spheres and support legs should be insulated (for fire protection), 3) The ground below spheres should slope towards a collection pit outside the sphere shadow (to avoid pooling under the sphere), 4) A deluge system capable of flooding the outer surface of the sphere should be provided (and regularly tested), 5) The drain system should include a remote-operated, accessible, fire-safe, quick shut-off valve (min. distance from the sphere), a throttle valve at least 1 m (3 ft) further downstream and a drain pot connected to a closed drain. The line should have welded joints (where practicable) and should be self-draining (no pockets) and well-braced (to minimise vibration). Screwed fittings should be prohibited (except for instruments), 7) Flammable gas detectors alarming to DCS should be provided (for early leak detection).

More Information

1) ARIA No. 1 https://www.aria.developpement-durable.gouv.fr/wp-content/files_mf/A1_ips00001_003.pdf

Industry Sector	Process Type	Incident Type
Oil & Gas	Liquified Gas Storage	Fire & BLEVE
Equipment Category	**Equipment Class**	**Equipment Type**
Mechanical	Vessel	Storage Sphere

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