Incident Title	**Multiple Naphtha Storage Tank Fires**	
Incident Type	Fire	
Date	25th October 1988	
Country	Singapore	
Location	Pulau Merlimau	
Fatalities	**Injuries**	**Cost**
0	25 (5 serious)	US$ 6.6 m (1988) – Ref. 1

Incident Description



Credit: The Straits Times/BP

Three identical floating roof tanks containing a total of 46,820 m^3 (294,500 bbls) of naphtha were completely destroyed in a major fire that took ~ 5 days to extinguish fully. Fortunately, no-one was killed but 25 people (mainly firefighters) were injured (5 seriously). The refinery was shut down for 15 days.

The 3 tanks were 41 m (135 ft) diameter x 20 m (66 ft) high and spaced 21 m (70 ft) apart within a common bund. Product levels were derived from manual tank gauging. Just before the incident, 1 of the tanks had been receiving sour straight run naphtha at a steady rate, but operators did not initially recognise that readings recorded in the daily log appeared to indicate a falling level. When this was realised, a visual check revealed the floating roof was partially submerged, so the incoming naphtha was diverted to another of the 3 tanks. Attempts to transfer product out of the stricken tank had to be stopped when the anti-rotation guide pole was seen to be physically displaced and the tank shell had been seriously deformed at the pole support attachment points.

The refinery fire service began to apply foam via the tank's fixed foam pourers to cover the surface of the exposed naphtha, but ignition occurred 10 minutes later and immediately developed to a full surface fire. The 2 adjacent naphtha tanks caught fire a few hours later, initially in their rim seal areas but rapidly developed to full surface fires. The fire was so intense it threatened to involve tanks containing other flammable products in adjacent bunded areas. Mutual aid partners and several government agencies assisted in fighting the fires.

Incident Analysis

Basic cause of the fire in the first tank was ignition of naphtha vapour either by friction sparks as the tilted, sinking roof scraped the anti-rotation pole or by static electricity sparks inadvertently generated by the application of foam.

Critical factors included: 1) Some roof pontoons were corroded and partially flooded (causing roof to tilt and hang-up on anti-rotation and gauge poles), 2) Heavy monsoon rain for 2 days prior to incident, 3) Centre well roof drain partially blocked (exacerbated tilting, enabled product backflow onto roof via emergency roof drain), 4) Remote island location (now part of Jurong Island).

Root causes included: 1) Inadequate tank maintenance (roof pontoons and drains), 2) Inadequate management of change (tank inspection and overhaul deferral), 3) Inadequate monitoring (product level, roof tilt), 4) Inadequate emergency response planning (failure to carry out performance testing of firewater distribution system, logistics of ferrying resources from mutual aid partners while evacuating non-essential personnel), 5) Inadequate process safety management (maintenance cost reduction prioritised over safety).

Lessons Learned

1) Roofs of open-top floating roof tanks should be regularly inspected during periods of unusually high rainfall, 2), Oil transfer into or out of the tank should be stopped immediately if a floating roof becomes jammed or sinks in order to mitigate the risk of ignition by friction sparks, 3) Foam or water should not be applied directly to the surface of a low-conductivity product, 4) Tanks should have automatic tank gauging with flow vs rate of level change alarms.

More Information

1) "Investigation of a Naphtha Storage Tank Fire", T.V. Rodante, Proc. Safety Prog. #24 (pages 98–107), American Institute of Chemical Engineers (2005).
2) "Liquid Hydrocarbon Tank Fires - Prevention and Response", BP Process Safety Series, IChemE, ISBN-13: 978-0-85295-528-4 (2008).

Industry Sector	Process Type	Incident Type
Oil & Gas	Oil Storage	Fire
Equipment Category	**Equipment Class**	**Equipment Type**
Mechanical	Vessel	Atmospheric Storage Tank