European Site #8 - Offsites (TKF)
Naphtha Storage Tank Full Surface Fire

Safety Impact			Environmental Impact		Production Impact		Damage
Fatalities	Injuries	First Aid	Leak Volume	Reportable	Days	Cost	Cost
0	0	3	Large	Yes	?	$$$	$$$

The Incident

A rim seal fire on a naphtha storage tank with an external ("open top") floating roof escalated to a full surface fire within 2 hours after vapours which had leaked into pontoons exploded causing the floating roof to sink. A foam attack was launched soon after the fire alarm was sounded but this failed due to inability to deliver foam to the tank (water pressure too low). An attempt was made to pump naphtha out of the tank but this also failed (naphtha became too hot to pump). The fire was allowed to burn overnight and a new foam attack was launched the following morning with additional high-capacity firefighting equipment. The fire was finally extinguished later that afternoon (total duration of the fire was approximately 30½ hours). There were no injuries (except dehydration from the heat) and no adjacent storage tanks or process equipment was impacted.

Background

The 46 m (150 ft) diameter tank had been designed to API 650 ("Welded Tanks For Oil Storage") and had been in service for approximately 43 years when the incident occurred. It had a single roof deck with 24 pontoons around its periphery. The primary seal was a pantographic type and was equipped with a single pressure relief valve (the "rim vent"). The purpose of the rim vent is to release air and non-condensable vapour from the rim space. The rim seal area did not have any fire detection system but was equipped with fixed foam pourers and a foam dam in accordance with NFPA 11 ("Standard For Low-, Medium- And High- Expansion Foam").

The tank contained sour unstabilised naphtha with a very high true vapour pressure (TVP). The TVP of the naphtha may have been higher than normal as the crude distillation unit (CDU) had been shut down and emptied the day before the incident. The naphtha was being pumped to the distillate hydrotreater (DHT) at a rate corresponding to the roof descending at approximately 4.0 cm/hr (1.6 in/hr).

Causes

The immediate cause of the initial fire was ignition of the flammable atmosphere in the rim seal area by a frictional spark created when the jammed floating roof released suddenly as the tank contents were pumped out. The rapid escalation to a full surface fire was caused by the floating roof sinking after one or more roof deck pontoons exploded (corrosion enabled naphtha vapour to leak into pontoons). Critical factors included 1) a defective or derailed rolling ladder (which caused the floating roof to jam) and 2) inadequate rim seal fixed foam pourers and inadequate immediate water pressure (these two factors extended the duration of the fire). The root causes were inadequate risk assessment of storing high TVP naphtha in a floating roof tank, inadequate inspection (failure to conduct routine explosimeter tests on the atmosphere inside the roof deck pontoons) and inadequate risk assessment of previous roof deck problems.

Lessons

Rim seal fires can quickly escalate into a full surface fire if the roof deck pontoons of a floating roof tank are leaking. Therefore, regular (at least 6 monthly) inspections should be carried out on all pontoons including explosimeter testing to determine if any of them contain a flammable atmosphere. Note that for a typical pontoon of 10 m^3 (353 ft^3) volume, a leak of just 0.8 litres (0.21 USgal) of gasoline will be enough to enable the atmosphere to reach the lower explosive limit (LEL). Rim seal fixed foam pourers should be regularly tested to verify they produce a good quality foam meeting the requirements of NFPA 11. The maximum recommended TVP for liquid products stored in single deck floating roof tanks is 76.5 kPa (11.1 psia). Exceeding this limit may result in vapour pockets collecting under the roof which can cause it to tilt, releasing vapour and increasing the risk of fire and/or sinking of the floating roof.

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