Incident Title	**Light Gas Oil Sidedraw Line Rupture**	
Incident Type	Fire	
Date	6th August 2012	
Country	USA	
Location	Richmond, CA	
Fatalities	**Injuries**	**Cost**
0	26	Unknown

Incident Description

Credit: US Chemical Safety Board

The light gas oil (LGO) sidedraw from a crude distillation unit (CDU) experienced a catastrophic pipe rupture, releasing a large volume of hot LGO to grade. The hot LGO partially vapourised and formed a large vapour cloud which engulfed 19 company employees. Approximately 2 minutes after the rupture occurred, the fluid ignited. Eighteen employees managed to escape from the vapour cloud before it ignited; the other was engulfed in the fireball but was wearing full-body firefighting protective equipment and managed to make his way to safety. Six employees suffered minor injuries during the incident and subsequent emergency response activity. A large plume of vapour, particulates and black smoke travelled across the surrounding area and approximately 15,000 people from neighbouring communities sought medical treatment over the next few weeks for a range of ailments such as breathing problems, chest pains, sore throats and headaches. Twenty of these were admitted to local hospitals for treatment as inpatients.

Incident Analysis

Basic cause was rupture of the LGO sidedraw piping caused by wall thinning due to high temperature sulphidation corrosion (HTSC).

Critical factors included: 1) Firefighters removed insulation from the leaking pipe to enable Operations and Maintenance specialists to determine if an on-line repair using a pipe clamp was feasible or if a unit shutdown would be required (the leak could not be isolated), 2) Failure to identify high corrosion rates in unmonitored low silicon (Si) carbon steel straight-run piping (due to corrosion measurement locations being located in high-Si fittings), 3) The relatively close proximity of local housing to the refinery perimeter fence.

Root causes included: 1) Inadequate design standards (ASTM A53B and other design codes used before 1985 did not specify a minimum Si content for carbon steel pipe), 2) Inadequate material selection (low Si carbon steel), 3) Failure to implement industry-recognised HTSC risk mitigation measures (conducting 100% component inspection on all high temperature carbon steel piping susceptible to sulphidic corrosion or upgrading to inherently safer materials of construction such as 5 Cr/0.5 Mo steel), 4) Inadequate risk assessment (allowing continued operation despite inability to isolate leaking pipe and failing to restrict the number of personnel entering a hazardous area), 5) Inadequate land use planning (close proximity of local housing).

Lessons Learned

1) In the absence of hydrogen, the rate of sulphidation corrosion depends on many factors such as concentration and type of sulphur compounds, fluid temperature and fluid flow rate, 2) Hydrogen sulphide (H_2S) is the most active sulphur species from corrosion perspective and sulphidic corrosion rates increase rapidly above 260 °C (500 °F), especially for carbon steel, 3) Carbon steels with silicon content of < 0.10 wt% are especially susceptible and can corrode at accelerated rates up to 16 times faster than carbon steel with a high Si content, 4) High chrome alloys offer excellent resistance to HTSC and are inherently safer than carbon steels when operating at temperatures above 260 °C (500 °F).

More Information

1) "Chevron Richmond Refinery Pipe Rupture and Fire", US Chemical Safety and Hazard Investigation Board, Report No. 2012-03-I-CA (2015).
2) API RP 939-C: Guidelines for Avoiding Sulfidation (Sulfidic) Corrosion Failures in Oil Refineries, 1st edition, Section 3.1.6, May 2009.

Industry Sector	Process Type	Incident Type
Oil & Gas	Atmospheric Crude Distillation	Fire
Equipment Category	**Equipment Class**	**Equipment Type**
Mechanical	Piping	Pipe

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