European Site #2 – Naphtha Splitter (NSU)
Dehexaniser Feed Line Rupture

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

The Incident

A large pool fire developed at the base of a dehexaniser (naphtha splitter) column. Fortunately, there were no injuries but there was significant fire damage to equipment and piping and a substantial opportunity cost (lost production) due to an extended unplanned outage while an investigation and repairs were carried out. The source of the leak was traced to a pipe rupture at the low point at the dead centre of the underside of a short horizontal section of the hydrotreated naphtha feed line close to the dehexaniser feed inlet nozzle.

Background

The function of the dehexaniser was to remove C5 and C6 hydrocarbons from full range hydrotreated naphtha feed for further processing in a C5/C6 Isomerisation unit. The remaining C6+ hydrocarbons were directed to the CCR Platforming unit. The dehexaniser column had an approximate overall height of 62.2 m (204 ft) including the skirt support. The feed inlet nozzle was located approximately 41.2 m (135 ft) above grade. The feed line at the leak location was fabricated from DN 200 (8" NS) Sch 40 killed carbon steel pipe (ASTM A106/A Gr. B) and had been properly coated with a solvent-based zinc primer and a silicone acrylic top coat. It had been in service for less than 14 years. The operating conditions at the rupture location were approximately 90 °C (194 °F) and 1.5 barg (22 psig).

Causes

The immediate cause of the fire was over-pressure and rupture of the dehexaniser feed line at the low point of a short horizontal section due to reduced wall thickness caused by corrosion under insulation (CUI); the leaking preheated sweet naphtha pooled at the base of the column and the resulting vapour cloud found an ignition source. Critical factors included: 1) existence of a clash between the insulated pipe and a structural member supporting an access platform, 2) delivery of the dehexaniser column to site with the feed piping already installed and insulated but access platforms omitted (these had to be installed in the field due to limited headroom beneath elevated piperacks which would have precluded transportation of the column through the refinery on a self-propelled multi-axle trailer), and 3) the affected section of pipe was located in an obscure position (beneath the access platform and approximately 30 m or 98 ft above grade). Root causes included: 1) inadequate design (failure to comply with the project piping standard which required a minimum 25 mm or 1" clearance between the insulated pipe and a structural member), 2) inadequate correction of non-compliant pipe installation (insulation and cladding cut away to address the pipe vs structural member clash), and 3) inadequate inspection and preventative maintenance (weatherproof sealant perished or absent).

Lessons

Corrosion under insulation (CUI) is typically caused when insulation gets wet due to water ingress beneath the weather barrier (jacketing), or moisture condensation from steam tracing leaks, cooling tower drift or ambient air in humid and windy climates (especially at coastal locations). It occurs where the underlying metal surfaces are not hot enough to keep insulation dry during normal operation and is therefore most prevalent on equipment with metal skin temperatures in the range -4 to 121 °C (25 to 250 °F). For equipment whose insulation and jacketing are damaged, metal temperatures low enough to cause CUI can occur even with process temperatures as high as 175 °C (347 °F).

The concealed nature of CUI makes it difficult and expensive to detect. Inspection ports can be cut into the insulation to enable periodic on-line inspection. However, CUI generally occurs as pitting corrosion and can be quite localised, so inspection ports will only reveal a tiny fraction of the potentially affected metal service. Consequently, best CUI management practice should include most or all of the following elements: 1) application of an organic coating to susceptible carbon steel surfaces; 2) exclusion of water by careful insulation system design and installation; 3) periodic stripping, abrasive blasting, repainting, and re-insulating; and/or 4) periodic inspection and non-destructive evaluation.