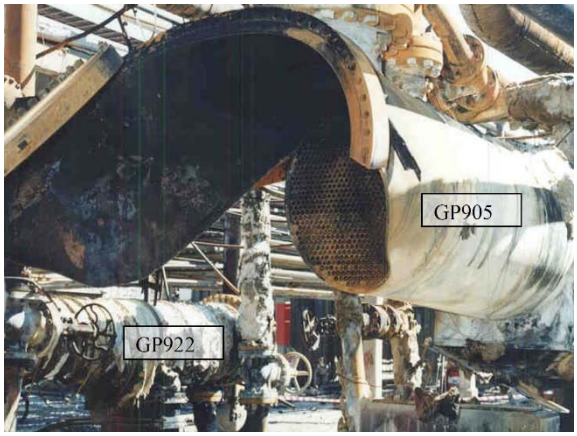
Australasian Site #101 - Gas Processing Plant (GPP)
Deethaniser Reboiler Catastrophic Failure



Safety Impact			Environmental Impact		Production Impact		Damage
Fatalities	Injuries	First Aid	Leak Volume	Reportable	Days	Cost	Cost
2	8	0	Large	Yes	>14	$$$$$$	$$$$$$

The Incident

On 25-Sep-98, a major upset occurred on Gas Plant 1 (GP1) at the Longford Plant in Gippsland, Victoria (Australia). GP1 was taken off-line and a few hours later, the rich oil deethaniser reboiler (GP-905) had become intensely cold and failed catastrophically when warm lean oil was re-introduced during restart. The failure released more than 10 tonnes of hydrocarbon vapour to atmosphere. The vapour cloud drifted some 170 m to a set of fired heaters and ignited. The flame front from the resulting deflagration burned through the cloud without causing an explosion. When it reached the ruptured exchanger, a fierce jet fire developed beneath an elevated piperack junction and flame impingement caused 3 more leaks. The resulting fire burned for more than 2 days. Two employees were killed and eight more were injured. Supplies of natural gas to domestic and industrial users throughout the state were halted for more than 2 weeks causing substantial losses to industry and massive inconvenience to people in their homes.

Background

The gas processing section of the Longford Plant incorporates a set of slugcatchers and 3 interconnected gas plants (GP1/2/3) to separate and purify raw gas from offshore gas fields to make natural gas for sales. GP1 is a 1969-vintage refrigerated lean oil absorption plant. GP2/3 are 1976- and 1983-vintage cryogenic separation plants, respectively.

On the day of the incident, an increase in raw gas flow caused a buildup of condensate in 1 of 2 parallel absorbers at GP1 and then an upset in the rich oil deethaniser (ROD). The upset caused the lean oil pumps to trip, resulting in a loss of warm lean oil flow to the ROD reboiler (GP-905). The pumps could not be restarted and the loss of lean oil inflow to the oil saturator tank caused rapid drawdown of the level in the tank which initiated an automatic trip of the high-head lean oil booster pumps feeding the absorbers and total loss of lean oil circulation. Meanwhile, the continuing buildup of condensate in one absorber resulted in condensate carryover to the rich oil system. The extended period without lean oil circulation resulted in the rich oil stream gradually being replaced by pure condensate. As this stream flashed across the pressure letdown valves on the rich oil outlet from the lean oil absorber, the feed to the rich oil flash tank dropped to -42 ºC (-44 ºF) and the feed to the rich oil deethaniser dropped to -48 ºC (-54 ºF). Metallurgical analysis of GP-905 showed that the tubesheet to channel weld had slowly cracked due to radial expansion of the tubesheet but the crack rapidly propagated through the embrittled channel causing the channel end to rip open.

Causes

The immediate cause of the initial fire was a loss of primary containment (LOPC) due to brittle fracture of GP-905 channel end. Critical factors included loss of lean oil flow for extended duration and absence of remote-operated valves to isolate interconnections with GP2/3. Root causes included inadequate hazard identification (low temperature hazard due to loss of lean oil not known), inadequate operating procedures (due to inadequate hazard identification), inadequate training, inadequate alarm management (poor prioritisation), inadequate monitoring by experienced engineers (located remotely) and inadequate safety management (Safety Case methodology not mandated or adopted).

Lessons

Cold metal embrittlement of carbon/low alloy steels is a low probability, high consequence hazard that is sometimes overlooked. Risk assessment can only be conducted against known hazards so it is imperative that comprehensive process hazard analysis (PHA) studies (eg. Hazop) are conducted on hazardous plant. However, even if this is done, some hazards may still be overlooked. Therefore, organisations should ensure their workforces always remain mindful of the possibility of disaster and are diligent in the reporting of incidents and their root causes (organisational learning).

Peter Marsh
Director – XBP Refining Consultants Ltd