


Incident Title		Propylene Fractionator Reboiler Shell Rupture	
Incident Type		Explosion and Fire	
Date		13 th June 2013	
Country		USA	
Location		Geismar, LA	
Fatalities		Injuries	Cost
2		167	US\$ 510 m (2014) – Ref. 2
Incident Description		<p>A Propylene Fractionator was equipped with 2 shell and tube-type reboilers (one in service, one on standby). The standby reboiler was being brought on stream to allow the operating reboiler to be taken off-line for cleaning. The Operations Supervisor opened the manual tubeside isolation valves to establish a flow of hot quench water to the standby reboiler in preparation for the reboiler switchover. Three minutes later the standby reboiler shell failed catastrophically. The escaping propane/propylene mixture caused a boiling liquid expanding vapour explosion (BLEVE) and fire, releasing approximately 13.6 tonnes (30,000 lb) of flammable hydrocarbons to atmosphere. The fire burned for 3.5 hrs and the plant remained shut down for 18 months.</p>	
 <p>Credit: US Chemical Safety Board</p>			
Incident Analysis		<p>Basic cause was overpressure of the reboiler shell during warmup due to thermal expansion of trapped (blocked in) propane/propylene liquid.</p> <p>Critical factors included: 1) The original Propylene Fractionator design had both reboilers operating continuously (so no shellside isolation valves) with over-pressure protection for both reboilers provided by a pressure safety valve (PSV) on top of the Propylene Fractionator, 2) Isolation valves were added to both reboilers in 2001 to enable the Propylene Fractionator to remain on-line while one of its reboilers was taken out of service for cleaning (the operating philosophy was changed to one reboiler in service, one on standby under a nitrogen blanket), 3) The standby reboiler shell was isolated from the PSV by its closed shellside isolation block valves, 4) The shellside isolation valve(s) leaked, allowing process fluid into the reboiler shell.</p> <p>Root causes included: 1) Inadequate management of change (MoC) review (for installation of reboiler isolation valves), 2) Inadequate documentation (P&IDs not updated to show isolation valves), 3) Inadequate process hazard analysis (PHA) study (both reboilers assumed to be in operation as P&IDs did not show isolation valves), 4) Inadequate hazard identification (potential for overpressure not recognised), 5) Inadequate procedures (absence of equipment-specific operating procedure for reboiler switching), 6) Inadequate pre-startup safety review (PSSR), 7) Failure to properly implement recommendations from 2006 PHA (car seal open shellside isolation valves), 8) Inadequate process safety management (PHA, MoC, PSSR and related action-tracking processes; failure to confirm existence of safety-critical car seals on shellside isolation valves).</p>	
Lessons Learned		<p>1) Single block (gate) valve is not an adequate method of isolation as valves can leak and are susceptible to inadvertent opening.</p> <p>2) A rigorous management of change (MoC) review should be carried out before any changes are implemented on process plant.</p> <p>3) Overpressure protection must be provided if the maximum allowable working pressure (MAWP) can exceed design code limits.</p> <p>4) PSVs (passive safeguards) installed directly on the equipment to be protected are higher in the hierarchy of controls and provide more robust protection than car seals and operating procedures (administrative controls).</p>	
More Information		<p>1) "Williams Geismar Olefins Plant Reboiler Rupture and Fire", US Chemical Safety and Hazard Investigation Board, Report No. 2013-03-I-LA (2016).</p> <p>2) "The 100 Largest Losses 1974 – 2013", Marsh Property Risk Consulting Practice, 23rd Edition (2014).</p>	
Industry Sector		Process Type	Incident Type
Petrochemicals		Olefins	Explosion & Fire
Equipment Category		Equipment Class	Equipment Type
Mechanical		Heat Exchanger	Shell & Tube