


Incident Title		Isobutane Release During Maintenance	
Incident Type		Fire	
Date		22 nd November 2016	
Country		USA	
Location		Baton Rouge, LA	
Fatalities		Injuries	Cost
0		4	Unknown
Incident Description		<p>One of two operators preparing equipment for maintenance on the sulphuric acid (H₂SO₄) alkylation unit attempted to open a manually-operated quarter-turn plug valve in the suction line of the standby isobutane recycle pump. However, the gearbox was found to be inoperable (the handwheel moved, but the valve did not open). One of the operators extracted the 4 vertical bolts which connected the gearbox support bracket to the valve body and removed the faulty gearbox so the valve stem could be turned using a pipe wrench. However, these same bolts also secured the pressure-retaining bonnet (“top-cap”). When the valve stem was turned, the bonnet separated from the valve body, releasing ~ 910 kg (2000 lb) of pressurised isobutane liquid to atmosphere. The escaping liquid formed a flammable vapour cloud which travelled ~ 20 m (70 ft) within 30 seconds and found an ignition source (believed to be an energised welding machine). The resulting fire severely burned an operator and 3 contractors who were working in the vicinity.</p>	
 <p>Credit: US Chemical Safety Board</p>			
Incident Analysis		<p>Basic cause was a release of isobutane caused by inadvertent removal of 4 bolts securing the pressure-containing bonnet to the body of a plug valve.</p> <p>Critical factors included: 1) Gearboxes on the alkylation unit’s many (~ 500) plug valves had poor reliability, 2) The subject plug valve was a 30+ year old design with 2 options for removing the gearbox support bracket (remove 2 horizontal bolts which directly attach the bracket to the gearbox or remove 4 vertical bolts which secure the bracket to the pressure-containing bonnet), 3) Although ~ 485 of the unit’s plug valves had already been replaced with a more modern design (gearbox support bracket not attached to bonnet), the other 15 (old) valves met the code requirement that the support bracket could be removed without affecting pressure envelope integrity so their replacement was not mandatory, 4) Removal of malfunctioning plug valve gearboxes by operators was accepted practice on this unit and had been done many times without incident on the more modern design of valve (false sense of security).</p> <p>Root causes included: 1) Inadequate equipment design (plug valve gearbox support bracket attached to bonnet rather than body flange), 2) Failure to apply hierarchy of controls (30+ year old valves not replaced with inherently safer design), 3) Inadequate hazard awareness (risk of breaching pressure containment when removing inoperable gearbox), 4) Inadequate process hazard analysis (human factors not considered or documented), 5) Absence of written procedures (plug valve gearbox removal), 6) Inadequate operator training (removing gearboxes from various types of plug valve), 7) Inadequate communication (valve manufacturer to refinery workers), 8) Failure to learn (poor gearbox reliability), 9) Inadequate process safety management.</p>	
Lessons Learned		<p>1) Consider human factors in process hazard analysis (e.g. recognise that use of different equipment types in the same service may cause confusion). 2) Apply the “hierarchy of controls” (inherently safe > passive protection > active protection > administrative controls) to mitigate identified hazards. 3) Provide written procedures for operators on how to do permitted minor mechanical tasks and when to call for specialist maintenance technician help. 4) Provide hazard awareness training to help workers perform tasks safely.</p>	
More Information		<p>1) “Safety Bulletin: Key Lessons from the ExxonMobil Baton Rouge Refinery Isobutane Release and Fire”, US Chemical Safety and Hazard Investigation Board (CSB), Report No. 2016-02-I-LA.</p>	
Industry Sector		Process Type	Incident Type
Oil & Gas		H ₂ SO ₄ Alkylation	Fire
Equipment Category		Equipment Class	Equipment Type
Mechanical		Valves – Manually operated	Plug valve