

Incident Title		Fire and HF Release	
Incident Type		Fire & Acid Release	
Date		19 th July 2009	
Country		USA	
Location		Corpus Christi, TX	
Fatalities		Injuries	Cost
0		2 (1 critical)	Unknown
Incident Description  Credit: US Chemical Safety Board		The isobutane (iC₄) recycle control valve on the hydrofluoric acid alkylation (HFA) unit is a double-ported valve with a top and bottom guided plug and a direct-actuating pneumatic diaphragm actuator configured to fail open. But on the morning of 19-Jul-09, the control valve failed closed. This caused the associated piping in the (low ppm HF-containing) iC₄ recycle loop to vibrate violently. Two threaded connections in the loop failed, resulting in a loss of primary containment (LOPC) and formation of a large vapour cloud which migrated to an adjacent process unit and ignited. The resulting fire burned for several days, causing extensive collateral damage and triggering multiple flange leaks in the HF acid section of the unit. One employee was critically injured in the fire; another was treated for possible HF exposure during the emergency response activities. The unit eventually restarted on 01-Nov-09. It was later reported that ~ 19 tonnes (42,000 lbs) of HF had escaped from the acid section of the HFA unit. It is believed the HF release mitigation (water curtain system captured around 90% (~ 17 tonnes or 38,000 lbs) of the lost HF. The remaining HF probably vapourised in the fire and the prevailing wind blew the (lighter-than-air) HF cloud towards the Corpus Christi ship channel.	
Incident Analysis		Basic cause of the initial fire was failure of 2 threaded connections in the iC₄ recycle system piping following violent vibration and movement of pipework due to sudden closure of the iC₄ recycle flow control valve caused by the internal valve plug lock pin separating from the valve stem. Critical factors included: 1) The manually-operated bypass valve associated with the failed iC₄ flow control valve was not accessible due to the size of the iC₄ release, 2) There was no remote-operated rapid acid deinventory (RAD) system to remove HF inventory from the process, 3) The stored water supply for fire suppression and HF release mitigation was almost exhausted within the first 12 hrs of the multi-day fire (a temporary backup system was hurriedly assembled and successfully used to pump salt water from the Corpus Christi ship channel via a firefighting barge into the refinery fire water system but suffered several hose ruptures and 2 pump engine failures while operational). Root causes included: 1) Inadequate process design (absence of a reliable backup firewater system for HF release mitigation in case stored firewater inventory runs out), 2) Inadequate equipment design (piping supports, control valve plug/stem attachment), 3) Failure to comply with industry standards (API RP 751 "Safe Operation of HF Acid Alkylation Units" recommends a third party safety audit of HFA unit operations is carried out every 3 years), 4) Inadequate process safety management (failure to conduct safety audits).	
Lessons Learned		1) Hydrogen fluoride (HF) is a colourless liquid which boils at about 20°C (67°F). It is highly toxic, corrosive and can cause severe burns to skin, eyes and other tissue. HF burns require immediate treatment by trained medics. 2) The refinery changed the (now obsolete) failed iC₄ flow control valve to a simpler, more robust single port cage guided plug valve and installed a fail-safe bypass valve that automatically opens if the control valve fails closed. 3) Quantitative HF release risk assessments should be updated if significant changes to HFA unit operation or societal risk are planned/expected.	
More Information		1) "Urgent Recommendations", US Chemical Safety and Hazard Investigation Board, (09-Dec-09): US CSB Investigation Report.	
Industry Sector		Process Type	Incident Type
Oil & Gas		Alkylation (HF)	Fire & Acid Release
Equipment Category		Equipment Class	Equipment Type
Safety & Control		Valves - Actuated	Control Valve (Plug)