



Fire from Ice: The Valero Refinery Fire

Leadership ViTS Meeting

December 2009

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THE MISHAP

February 16, 2007: Propane gas leaked from the McKee Refinery's Propane Deasphalting Unit in Sunray, Texas. As winds carried the vapor cloud, a spark ignited the propane and the entire cloud burst into flames. The fire spread quickly, forcing evacuation of the refinery as firefighters battled the blaze. Three workers suffered serious burns and the refinery was shut down for two months. Gas prices increased nine cents per gallon in the west.

Propane Deasphalting (PDA) Unit:

In 1992, a control station in the PDA unit was shut down.

Rather than remove or positively isolate the idle subsection, operators simply closed the six-inch valves around this section.

This intentionally created a "dead-leg" of pipes that were supposed to have nothing flowing through them.

In actuality, a foreign object blocked one of the valve seats, preventing it from sealing completely.

Sometime during the isolation period of fifteen years, water passed through the jammed valve and settled.

Although the operating sections had freeze protection, the "dead-leg" did not.



WHAT HAPPENED?



The “Dead Leg” reaches its breaking point:

- In February 2007 a four-day cold front froze the water in the dead-leg, causing it to expand and crack the pipe.
- When the ice thawed, propane escaped through jammed valve and out the crack at 4,500 pounds per minute.
- Wind carried the propane vapor cloud toward a boiler house, where it likely found an ignition source.

Fighting Fire From Ice:

- A high-pressure propane jet fire launched into a steel column supporting a pipe bridge filled with petroleum products, further fueling the fire.
- The fast propagation of the fire prevented operators from closing the manual valve shutoffs to cutoff the fuel for the fire.
- The fire was finally extinguished approximately 24 hours later.

ROSOV's: If remotely operated shut-off valves (ROSOV's) had been installed, responders would have been able to remotely isolate the propane flow to the fire.



PROXIMATE CAUSE

Freezing water cracked a pipe that had been unused for fifteen years. Propane gas leaked through the crack, forming a vapor cloud. An ignition source, probably from the boiler room, ignited the gas and the fire flashed back through the propane cloud.

ROOT CAUSE / UNDERLYING ISSUES

Unknown Dead-Leg:

- There was no record that the refinery conducted a formal management of change review when the control station was taken out of service.
- Valero did not have a formal written program to identify, review or freeze-protect dead-legs and other infrequently used piping.

Process Hazard Analysis (PHA) Finding Erroneously Closed Before Completion:

- A Process Hazard Analysis (PHA) performed by the previous refinery owner in 1996 identified the need for ROSOV's; none were installed, yet the action item was checked complete.
- Valero's 2006 PHA did not revisit findings from the 1996 PHA and violated its own requirements by not installing the ROSOV's.

Inadequate Fire Protection Standards:

- Fire-proofing standards required fire protection for piping within 50 feet of a potential source.
- Steel columns within 30 feet of the PDA unit had been fireproofed, but unprotected pipe 77 feet away was not fireproofed and collapsed in the fire.
- The unprotected pipe was listed in a loss-prevention report as a fireproofing "top-priority" but had not been fireproofed by February 2007.

Managing Unused Equipment:

Discontinued components attached to a system still pose a safety risk.

- Develop controls that detect and correct latent conditions in unused equipment or facilities.
- Conduct and verify hazard analyses to determine where and how hazards might arise.
- Review decisions to 'mothball' a system and, if sections must remain, render them inert (incapable of energy release).

Evaluate Possible System Outcomes:

- Calculate actual energy releases possible within a system to be realistic when estimating safety margins.
- Consider environmental effects on a process, especially when environmental changes are intermittent or cyclic rather than constant.
- Include 'damage control' capability into the system where mass and other considerations allow.
- Isolate sources where high energy release potential exists, to contain component or assembly failures from initiating a chain reaction leading to system failure.

