CSB Determines Massive Propane Fire at Valero Refinery in Sunray, Texas, Resulted from Water Freezing and Cracking Idle Section of Process Piping

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Amarillo, Texas, July 9, 2008 - A massive fire that injured four workers and caused the total shutdown and evacuation of the Valero McKee Refinery in Sunray, Texas, in February 2007 likely occurred after water leaked through a valve, froze, and cracked an out-of-service section of piping, causing a release of high-pressure liquid propane, the U.S. Chemical Safety Board (CSB) said in a final investigation report issued today.

The CSB released a new 13-minute safety video to accompany the final report, including a 3-D computer-generated animation depicting the accident scenario. The video has been posted on the Board's website, CSB.gov, and on YouTube. DVD copies are available free of charge using an online request form.

The CSB's final report concluded the root causes of the accident were that the refinery did not have an effective program to identify and freeze-protect piping and equipment that was out of service or infrequently used; that the refinery did not apply the company's policies on emergency isolation valves to control fires; and that current industry and company standards do not recommend sufficient fireproofing of structural steel against jet fires.

"This was a significant accident that seriously burned three people, shut down a major oil refinery for two months, and contributed to gasoline shortages hundreds of miles away in Denver," said CSB Chairman John Bresland. "The CSB investigation points to a number of areas where oil industry practices should be improved to reduce the likelihood and the severity of process-related fires. Fireproofing, remotely operable shutoff valves, and effective water deluge systems can spell the difference between a small, quickly contained fire and an massive blaze that cripples a large industrial facility."

The fire occurred in the refinery's propane de-asphalting unit, which uses high-pressure propane as a solvent to separate gas oil from asphalt; gas oil is used as a feedstock in other gasoline-producing refinery processes. The propane leaked from an ice-damaged piping elbow that is believed to have been out of service since the early 1990s, CSB investigators said. Unknown to refinery personnel, a metal object had wedged under the gate of a manual valve above the piping elbow, allowing liquid to flow through the valve. Piping above the valve contained liquid propane at high pressure, and small amounts of water were entrained in the propane.

"The elbow was part of a 'dead-leg' formed when the piping was taken out of service," said CSB Investigations Supervisor Don Holmstrom. "This was a section of piping that remained connected to the process but was not intended to have any flow of liquid through it. Dead-legs can pose special hazards in refineries that should be carefully managed." Mr. Holmstrom said the refinery, then owned by Ultramar Diamond Shamrock, did not identify hazards arising from the dead-leg when it was created in the 1990s and did not implement safeguards, such as removing the piping, isolating it from the process using metal plates known as blinds, or protecting it against freezing temperatures.

Over time, water seeped past the leaking valve and built up inside the low point of the piping elbow. A period of cold weather in early February 2007 likely caused the water to freeze, expand, and crack the piping. On February 16, the daytime temperature increased and the ice began to melt. At 2:09 p.m. high-pressure liquid propane flowed through the leaking valve and was released through the fractured elbow. Investigators estimated that propane escaped from the pipe at an initial rate of 4,500 pounds per minute, quickly creating a huge flammable vapor cloud, which drifted toward a boiler house where CSB investigators believe it contacted an ignition source.
"Once the fire started, there was no way to shut off the supply of fuel, because the refinery had not implemented Valero procedures requiring the installation of remotely operable shutoff valves," Mr. Holmstrom said. "Such valves are especially critical in high-pressure service to prevent large inventories of flammable material inside process equipment from contributing to a fire."

The growing fire caused the failure of a pipe flange on a large extractor tower filled with propane, igniting a powerful jet fire that was aimed directly at a major pipe bridge carrying liquid products throughout the refinery. Because the pipe bridge supports were not fireproofed, they quickly collapsed, severing process pipes that were essential to the operation of the refinery.

"Valero and industry standards require fireproofing of structural steel supports up to a maximum of 50 feet from possible fuel sources," said Mr. Holmstrom. "The collapse of a non-fireproofed pipe bridge 77 feet away from the source of the jet fire indicates that industry practices need to be revised."

The fire at Valero also caused the release of an estimated 5,300 pounds of toxic chlorine from three one-ton cylinders stored 100 feet from the fire. The chlorine, used to disinfect cooling water, could have posed a serious threat to emergency responders had they not already been evacuated, investigators said. In addition, the fire threatened a large spherical tank that contained up to 151,000 gallons of highly flammable liquid butane. As a result of the growing fire, the valves controlling a water deluge system designed to cool the sphere became inaccessible to operators and could not be opened.

"The consequences of this accident could have been even more serious, under slightly different circumstances," Chairman Bresland said. "Refineries should minimize the presence of hazardous substances near units where they may be exposed to fire hazards and should ensure that emergency systems remain operable if a disaster strikes."

The CSB made recommendations to the American Petroleum Institute (API), a leading oil industry trade association that develops safety practices that are widely followed in the U.S. and overseas. The Board called on the API to develop a new recommended practice for freeze-protection of refinery equipment and to improve existing practices related to fireproofing, emergency isolation valves, and water deluge systems. The report also called on Valero Energy Corporation, the nation's largest refiner, to improve freeze protection, fireproofing, hazard analysis, and emergency isolation procedures at its 17 North American refineries.

The CSB urged Valero to implement its strategic plan to eliminate the use of chlorine for water treatment in favor of inherently safer alternatives such as bleach. The Board also recommended that McKee refinery staff work with the United Steelworkers, which represents employees at the plant, to upgrade hazard analysis procedures.

The CSB is an independent federal agency charged with investigating industrial chemical accidents. The agency's board members are appointed by the president and confirmed by the Senate. CSB investigations look into all aspects of chemical accidents, including physical causes such as equipment failure as well as inadequacies in regulations, industry standards, and safety management systems.

The Board does not issue citations or fines but does make safety recommendations to plants, industry organizations, labor groups, and regulatory agencies such as OSHA and EPA. Visit our website, www.csb.gov.

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