

Loss of Containment

A key concept in Process Safety Management is the prevention of loss of containment.

In the process industries loss of containment typically refers to liquids and gases, this describes a situation where dangerous substances escape from pipes, pumps, tanks, containers, etc.

However, when evaluating hazards sight should not be lost in the potential major accident that may be triggered by loss of containment of energy caused by falling equipment and electrical leakage.

This relates to incidents where solids (eg. metal structures and equipment) are projected through the air, fall from height, etc. In the vast majority of major accidents, loss of containment is the principle cause.

Example One: *Loss of Containment – Vessel Overfill – CAPECO Overfill of Vessel*

On the night of October 23, 2009, a large explosion occurred at the Caribbean Petroleum Corporation (CAPECO) facility in Bayamón, Puerto Rico, during offloading of gasoline from a tanker ship, the *Cape Bruny*, to the CAPECO tank farm onshore. A 5-million gallon aboveground storage tank (AST) overflowed into a secondary containment dike.



The gasoline spray aerosolized, forming a large vapour cloud, which ignited after reaching an ignition source in the wastewater treatment (WWT) area of the facility. The blast and fire from multiple secondary explosions resulted in significant damage to 17 of the 48 petroleum storage tanks and other equipment onsite and in neighbourhoods and businesses offsite. The fires burned for almost 60 hours. Petroleum products leaked into the soil, nearby wetlands and navigable waterways in the surrounding area.

Example Two: *Loss of Containment – Gas – Explosion at Pemex Reynosa*

An explosion at a natural-gas distribution plant near the US-Mexico border city of Reynosa in mid-September 2012 killed 30 workers and injured another 46.

The plant measures natural gas extracted from neighbouring wells and transfers the fuel to a nearby processing plant, which separates liquid hydrocarbons from the gas.



Example Three: *Loss of Containment – NDK Crystal Pressure Vessel Failure*

A large explosion at the NDK America Inc. plant launched debris 300 yards fatally injuring a member of the public. Two individuals were reported to have sustained minor injuries and were treated onsite. The facility is a manufacturer of quartz crystals in Belvidere, Illinois, approximately 60 miles northwest of Chicago.

On December 7, 2009, at approximately 2:30 pm, State Special Vessel No. 2, under an operating pressure of 29,000 psig, suddenly and violently ruptured, 120 days into a 150-day operating cycle. A white cloud of steam and debris rapidly expanded outward from the facility, travelled onto the interstate, and dissipated within seconds.

The sudden release of superheated liquid caused an eight-foot tall by four-foot wide vessel fragment, weighing approximately 8,600 pounds, to travel through two concrete walls and finally land about 435 feet from the NDK building. The fragment skipped across a neighbouring facility parking lot and slammed into the wall of an adjacent business office. The force of the impact pushed the wall inward causing furniture to shift and ceiling tiles to fall. One person working near the wall was injured.



The thrust from the escaping liquid caused the base of the vessel to violently shear away from its foundation and blew pieces of structural steel out of the building into the parking lot of a nearby rest stop gas station, known as the Illinois Tollway (I-90) Oasis. One piece of structural steel struck and killed a truck driver at the rest stop. After shearing from its base and throwing shrapnel out of the facility, the vessel swung from the building and landed on the ground outside.

Source: USCSB Case Study