A vapor cloud explosion occurs when a sufficient amount of flammable or combustible material is released, mixes with air, and is ignited. Some causes of the release of the vapor or gas fuel include:

• Loss of process containment from failure of a pipe, reactor, storage tank, or other process vessel containing flammable or combustible liquid, or a flammable gas.
• Rapid discharge of flammable vapor to the atmosphere through a pressure relief system.
• Release of flammable liquid stored under pressure – for example, Liquefied Petroleum Gas (LPG). The discharged liquid will rapidly boil at atmospheric pressure, forming a flammable vapor cloud.

If the flammable vapor cloud is ignited, it can explode, producing a blast wave which can cause major destruction at a large distance. This is particularly true for releases in congested or confined areas, for vapor clouds that have drifted into such areas, and for reactive materials. In addition, heat from the fireball can cause significant injury or damage.

Some of the worst disasters in the history of the process industries have been vapor cloud explosions. Some examples include:

• June 1974, Flixborough, England (28 fatalities)
• October 1989, Houston, Texas (23 fatalities)
• March 2005, Texas City, Texas (15 fatalities)
• December 2005, Buncefield, England (no fatalities but 43 injuries and major damage)
• October 2009, Jaipur, India (12 fatalities)

Keep flammable materials inside the process equipment!