The Phillips 66 Plant Explosion
Pasadena, TX
October 23, 1989

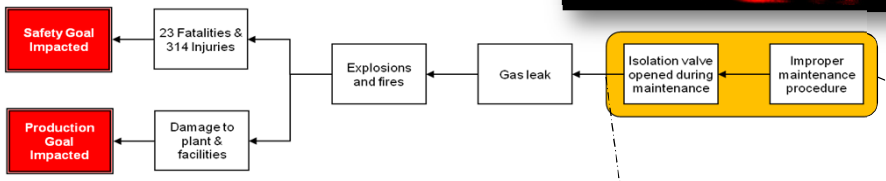
On October 23, 1989, the Phillips 66 Petroleum Chemical Plant near Pasadena, Texas, then producing approximately 1.5 billion of high-density polyethylene (HDPE) plastic each year, suffered a massive series of explosions. 23 died and hundreds were injured in an explosion that measured at least 3.5 on the Richter scale and destroyed much of the plant.

Step 1. Outline the Problem

What	The Issue(s)	Explosions at Phillips 66's Houston Chem Complex	
When	Date	October 23, 1989	
	Time	1:00 PM	
	Differences	Occurred during maintenance	
Where	Physical Location	Near the Houston Ship Channel in Texas	
	Process Location	HDPE Plant	
	Work Process	Maintenance work on reactor legs	
Impact to the Goals			
Safety		23 fatalities; 314 injuries	
Environmental		Explosion debris spread over 6 mi radius	
Compliance		Fine	$4,000,000
Production-Schedule		Business disruption loss	$700,000,000
Materials, Labor		Damage to plant & facilities	$715,000,000
		This incident	$1,419,000,000
	Frequency	Once every ten years (Average)	
		Annual Total	$141,900,000

Step 2. Cause Map

High and Intermediate Levels

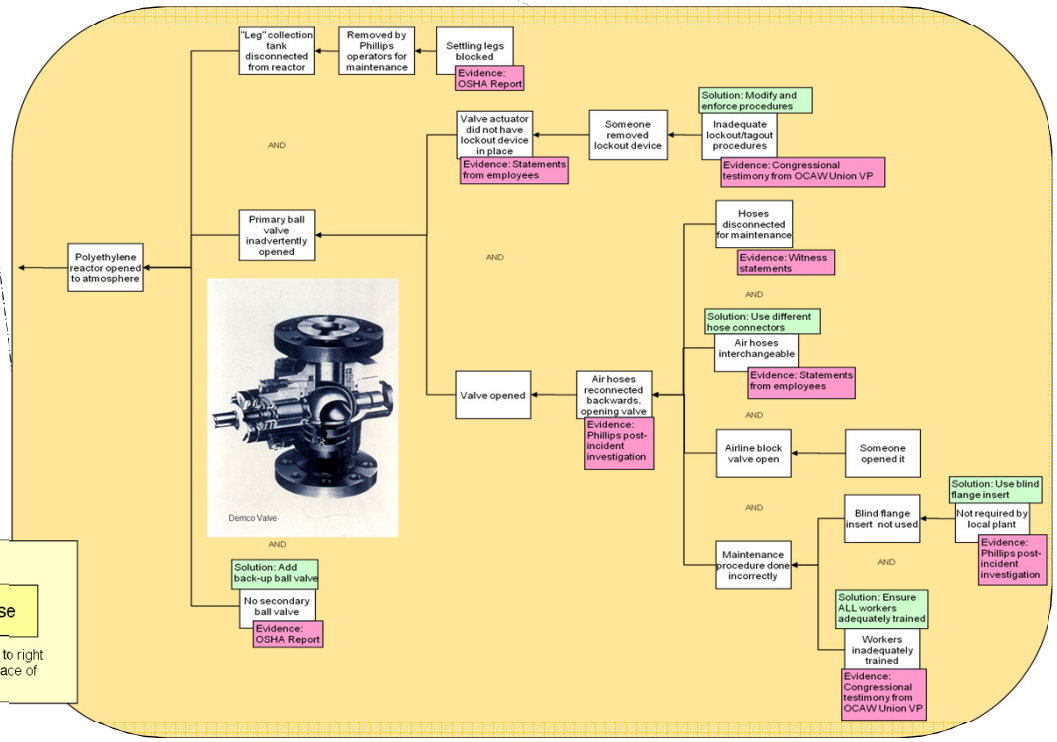


To easily understand the underlying reasons behind the Phillips 66 Explosion of 1989, a high-level Cause Map provides a quick overview of the event. Breaking a section of the Cause Map down further can provide significant insight into the multiple reasons the event occurred. The associated PDF for this case shows how different levels of a Cause Map can provide just the right amount of detail for understanding a complex problem such as this one.

Looking at the Phillips 66 Explosion Cause Map, one can see how a series of procedural errors occurred that fateful day. Contract workers were busy performing a routine maintenance task of clearing out a blockage in a collection tank for the plastic pellets produced by the reactor. The collection tank was removed, and work commenced that morning. However, at some point just after lunch, the valve to the reactor system was opened, releasing an enormous gas cloud which ignited less than two minutes later.

The subsequent OSHA investigation highlighted numerous errors. First, the air hoses used to activate the valve pneumatically were left near the maintenance site. When the air hoses were connected backwards, this automatically opened the valve, releasing a huge volatile gas cloud into the atmosphere. It is unknown why the air hoses were reconnected at all. Second, a lockout device had been installed by Phillips personnel the previous evening, but was removed at some point prior to the accident. A lockout device physically prevents someone from opening a valve. Finally, in accordance with local plant policy but not Phillips policy, no blind flange insert was used as a backup. The insert would have stopped the flow of gas into the atmosphere if the valve had been opened. Had any of those three procedures been executed properly, there would not have been an explosion that day. According to the investigation, contract workers had not been adequately trained in the procedures they were charged with performing.

Additionally, there were significant design flaws in the reactor/collector system. The valve system used had no mechanical redundancies; the single Demco ball valve was the sole cut-off point between the highly-pressurized reactor system and the atmosphere. Additionally, there was a significant design flaw with the air hoses, as alluded to earlier. Not only were the air hoses connected at the wrong time, but there was no physical barrier to prevent them from being connected the wrong way. This is the same reason North American electrical plugs are mechanically keyed and can only be plugged in one way. It can be bad news if connected incorrectly! Connecting the air hoses backward meant the valve went full open, instead of closed. Both of these design flaws contributed to the gas release, and again, this incident would not have occurred if either flaw was absent.



Why?

Effect ← Cause

NOTE: Read the Cause Map from left to right with the phrase "Was Caused By" in place of each arrow.