

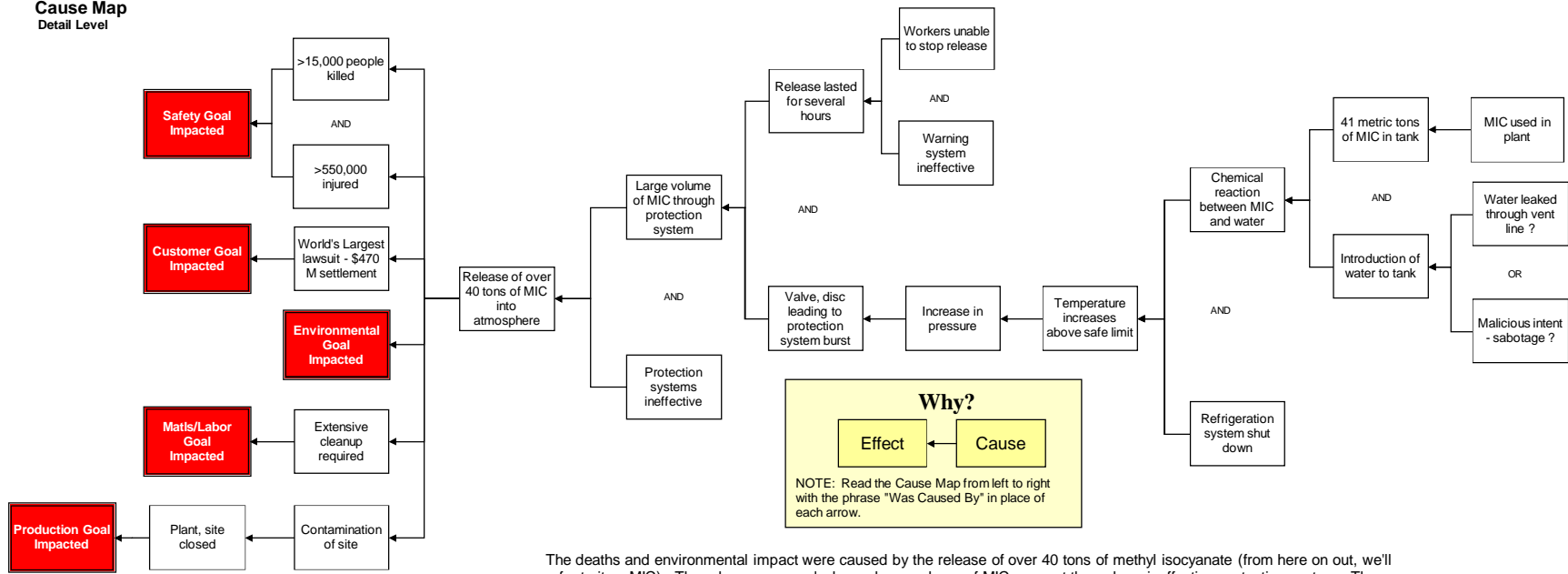
Vapor Release in Bhopal, India December 3, 1984

In the wee morning hours of December 3, 1984, over 40 tons (this amount is debated, but 40 tons appears to be the most popular, purely based on number of references that mention it) of methyl isocyanate (MIC) were released over the community of Bhopal, India, with a population of 900,000. Partially because of the transient nature of the population, and partially due to the general obfuscation of data from all sources involved, the number killed ranges from 2,000 to 15,000. The 2003 annual report of the Madhya Pradesh Gas Relief and Rehabilitation Department stated that a total of 15,248 people had died as a result of the gas leak. Based on claims accepted by the Indian government, there were at least 500,000 injured. This led to what has been called "The World's Largest Lawsuit", which I assume refers to the number of people represented, and certainly not the monetary amount of the settlement, which is a paltry \$470 million. After the accident, the plant, after a series of legal maneuvers, was abandoned. Extensive cleanup was required, and still has not been completed. The impact to the goals are shown in the outline to the right.

What	Problem(s)	Toxic vapor leak
When	Date	December 3, 1984
	Time	Just after midnight
	Differences	Production down, performing maintenance
Where	Physical Location	Bhopal, India
	Unit/Process/Equipment	Methyl isocyanate (MIC) production unit
	Work/Task Being Done	Maintenance

Impact to the Goals		
Safety	>15,000 dead	
	>550,000 injured	
Environmental	Release of 25 tons of toxic gas into community	
Production-Schedule	Plant closed	
Cust. Service	Settlement to gov't ("World's Largest Lawsuit")	\$470 M
Materials, Labor	Extensive cleanup required	\$2 M
	Estimated economic, legal & medical costs	\$4 B

Cause Map Detail Level



Why?

Effect ← Cause

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

The deaths and environmental impact were caused by the release of over 40 tons of methyl isocyanate (from here on out, we'll refer to it as MIC). The release occurred when a large volume of MIC was put through an ineffective protection system. The release lasted several hours, because workers were unable to stop it, and because of an ineffective warning system. The release occurred when a disk and valve that led to the protection system burst due to an increase in pressure. The increase in pressure was caused by an increase in temperature resulting from a reaction between MIC and water when the refrigeration system was shut down. There were 41 metric tons of MIC in the tank, stored for use in the plant. How the water was introduced is the debate in the two theories I mentioned above. But regardless, water got in to the tank, either by sabotage or by leaking through a vent line. We will probably never know exactly what happened. But we do know that ineffective safety systems can result in a massive loss of life, as happened here.

