



Engineering Ethics: The Bhopal Disaster

An Online Continuing Education Course for Engineers

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Prologue

The leak began shortly after midnight on December 3, 1984. The evening was cool, and methyl isocyanate gas (MIC) is heavier than air; the gas cloud stayed close to the ground as it spread. The wind carried it to the thousands of residences in the shantytown surrounding the plant. Forty tons of MIC phosgene, hydrogen cyanide and other gases traveled about 5 miles south and southeast before dissipating. The cloud covered two-thirds of the city for about two hours.¹

The neighborhoods in the Bhopal shantytown around the plant were the poorest of the poor and the residents of the lowest caste. The homes were shacks pulled together from scraps, which were easily infiltrated by the toxic gases.

The city was sleeping when the leak began and many people died in their beds. Hundreds of thousands woke choking from the lethal mix. The gas burned nasal passages, lungs and eyes. People vomited, many vomiting blood. Pregnant women hemorrhaged.

Panic and hysteria ensued. People scrambled to evacuate, families were separated and family members were sometimes left behind as individuals rushed to save themselves. People rushed out of their homes and into the more concentrated gases outside. Most of the dead were children, elderly and the weak.

Thousands of animals and birds were killed as well.

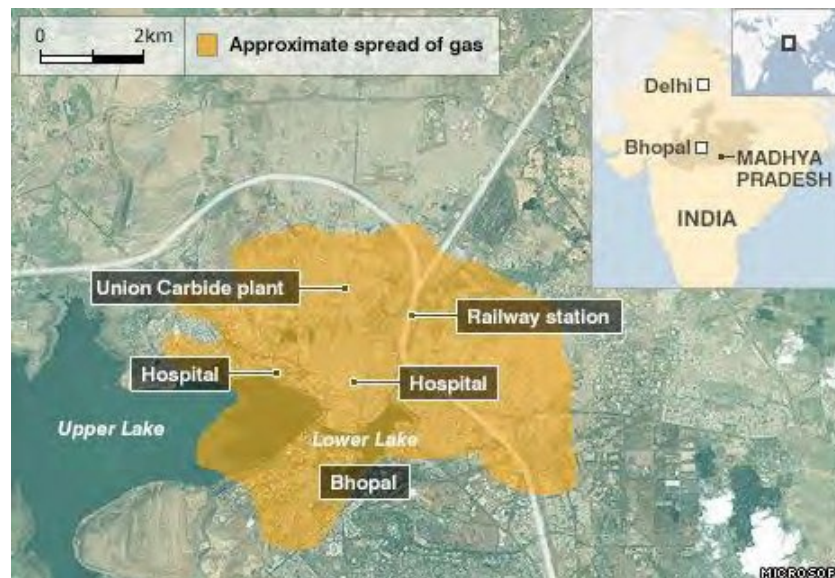


Figure 1: The estimated spread of gas from the Bhopal Plant following the leak

Residents and emergency responders had never been informed of the type of chemical hazards present or given instructions on actions to be taken in the event of a gas leak. People were unaware that the simple measure of applying wet cloths to their faces would provide some protection and relief.

No evacuation plans had been developed or communicated to residents or emergency responders. The area was very densely populated, animals such as cattle lived among the residents, and the road system was poor, impeding evacuation and hindering rescuers.

The deaths and most serious injuries occurred in the areas south and southeast, where the bulk of the gas drifted. Those who lived north of the plant experienced burning eyes and respiratory problems, but no deaths were reported.

The Union Carbide India Limited (UCIL) plant, the source of the gas, was equipped with emergency sirens to alert the plant and community of danger, but the public sirens weren't turned on until after 2:00 a.m. This delayed or prevented people from fleeing the area and seeking safety.

Shortly after the leak began, the local police noticed that their eyes were burning and attempted to call plant managers several times. They were repeatedly told that nothing was wrong until finally receiving the response "we don't know what happened."

Contacted at home, the work's manager is reported to have said, "The gas leak just can't be from my plant. The plant [MIC production] is shut down. Our technology just can't go wrong, we just can't have such leaks."²

Employees at the J.K. Straw Products Company contacted the Sultania Infantry Lines for help after noticing the gas. The Army ran an evacuation operation from 3 a.m. to 6 a.m.

Later, about 250 physicians from other parts of India rushed in to help the overwhelmed hospitals and local health professionals. The doctors had inadequate information on the nature of the gases and the appropriate treatments, frustrating efforts to aid the survivors.

Within a day, the state government reported 269 human deaths and 2,000 individuals requiring hospitalization.³

Symptomatic of the highly contentious nature of the case, death estimates vary, sometimes substantially. Two weeks later death estimates were as high as 2,000, with as many as 200,000 injured.⁴ The Boston Globe cites government sources as estimating 4,000 immediate deaths, with a total of 15,000 deaths over all.⁵ Given the extreme poverty of the area, the lack of death certificates, and the informal burials and mass graves, the exact totals will never be known.



Figure 2: Casualties of the Bhopal Disaster

MIC is a chemical used to produce carbamate insecticides and herbicides and is extremely toxic to humans.

“Other effects noted from acute inhalation exposure to methyl isocyanate in humans are respiratory tract irritation, difficulty breathing, blindness, nausea, gastritis, sweating, fever, chills, and liver and kidney damage. Survivors continue to exhibit damage to the lungs (e.g., bronchoalveolar lesions and decreased lung function) and the eyes (e.g., loss of vision, loss of visual acuity, and cataracts)...

After the Bhopal, India, accident, an unusually high percentage of survivors had disorders of the reproductive system, including leukorrhea, pelvic inflammatory disease, excessive menstrual bleeding, and suppression of lactation. Other adverse effects included increases in the number of stillbirths, spontaneous abortions, and increased infant mortality.”⁶

Introduction

Decades later, the disaster in Bhopal remains the subject of intense controversy. Critics allege negligence, indifference and racism on the part of UCIL’s parent company, Union Carbide Corporation (UCC) and allege that the accident was the result of faulty and poorly maintained equipment. UCC’s production facility in Institute, WV was older than the Bhopal plant, yet was built to a higher safety standard and used significantly more sophisticated technology than its Bhopal counterpart.

UCC’s investigation concluded that the accident was an act of sabotage and that a disgruntled employee deliberately introduced water into the MIC unit, causing the exothermic reaction that led to the fatal leak.

UCC provided immediate financial and technical aid to India and the survivors. Decades of litigation followed the disaster and UCC eventually paid a \$470 million settlement to the Indian government.⁷ Some critics believe the assistance and settlement to be inadequate.

The Station House Officer at the local police station observed the deaths from the leak and arrested 5 UCIL officers on December 3, 1984, charging them under Section 304 (A), “causing death by negligence or any rash act”. On December 7, 1984, Warren Anderson (Chairman – UCC), Keshub Mahindra (Chairman – UCIL), and V.P.Gokhale (Director – UCIL) arrived in Bhopal and were arrested; they were released on bail shortly afterwards.

In 2010, eight Indian former employees of the plant were convicted of “death by negligence.”

UCC merged with Dow Chemical in February 2001 and business is no longer conducted under the Union Carbide corporate name. This course will cite the company as UCC, the name at the time of the disaster.

A variety of sources, both critical and supportive of UCC, are used in an attempt to achieve balance. The intent herein is to set out the facts and opinions as presented by both sides. The reader is encouraged to weigh the arguments, form personal decisions on the ethical implications and apply them to the Bhopal case and the type of situations confronted daily in his or her own professional practice.

Much of the critical material is taken from N.D. Jayaprakash’s report, *The Bhopal Gas Leak Disaster: UCC’s Heinous Crime and Response of the Indian State*. Jayaprakash’s report is published by the Delhi Science Forum, which describes itself as a public interest organization. Its concerns include the “social, economic and political implications” of science and technology and among its goals is “improving the quality of life and removing social and economic disparities. Delhi Science Forum also believes in opposing all forms of obscurantism and stands for promoting scientific temper in society.”⁸

UCC’s reports, press releases and court documents are cited to provide the company’s perspective.

The work of Themistocles D'Silva, *The Black Box of Bhopal: A Closer Look at the World's Deadliest Industrial Disaster*, is a significant source in this case study. Mr. D'Silva retired from UCC in 1993 and his introduction to the book states that he seeks to provide an “objective, comprehensive account” and avoid “emotions and other agendas”.⁹

Course Objectives

This course will devote little time to the cause of the leak. Regardless of the source of the initiating event, it is more important to investigate the events that lead to the disaster, the failures of the emergency systems that should have detected and prevented the disaster and the ethical issues surrounding the responsibility of the parties involved.

Readers are encouraged to consider the following issues as they read the course material.

1. What design factors contributed to the disaster? What design elements should be incorporated to avoid the types of problems that occurred in Bhopal?
2. How did the culture of a developing country impact the operation of the plant? How does the design engineer deal with the issues involved in the operation of a facility staffed with uneducated and illiterate workers, particularly those in a culture foreign to the designer?
3. What communications and management issues are involved in the operation of a facility in another country?
4. How did the Indian government's policies and regulations contribute to the problems? Do governmental regulations change the ethical responsibilities of engineers and companies?
5. Is it sufficient for an engineer to design to what may be minimal safety and environmental requirements in another country?

The following portions of the National Society of Professional Engineers (NSPE) Code of Ethics provide the basis for the course:

I. Fundamental Canons

1. Engage only in those activities for which you are properly qualified by education, training, and experience.

II. Rules of Practice

1. Engage in professional engineering only when you are properly licensed.
 - a. If you are not properly licensed, you shall not represent yourself as an engineer or hold yourself out as an engineer in any way that would be likely to deceive the public, endanger life or property, or otherwise be detrimental to the public interest or the honor and integrity as may be required by the laws of the state or country.
 - b. Engage in professional engineering only when you are properly licensed and in conformity with the laws of the state or country.

To view the remainder of the course material and to take the quiz for PDH credit, you must purchase the course.

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Historical Environment

A basic understanding of the historical environment of India and the ongoing relationship between India and the world is necessary to understand the Bhopal disaster.

The British East India Company was established in India in 1612 and traded Indian goods in Great Britain and around the world. In the ensuing years, known as the period of "Company rule", the Company incrementally attained greater influence in India. Its dominion in India ended in 1858, when rule was transferred entirely to the British Empire.

In the 18th century, Britain terminated Indian imports and used India solely as a source for raw materials. Indian goods could not be sold in Britain, but British goods were sold in India. These policies destroyed the livelihoods of Indian merchants, craftsmen and workers, and numerous Indian industries. As a result, the country was plagued by economic stagnation, poverty, illiteracy, and recurring plagues and famines.