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Review Essay

The Railway Men

Revisiting the Government Response to an Environmental Disaster

Atharv Jain | ORCID: 0009-0001-1300-3441
Cornell University, New York, USA
aj479@cornell.edu

Pankaj Jain | ORCID: 0000-0003-3906-0855
FLAME University, Pune, India
pankaj.jain@flame.edu.in

Abstract

The Bhopal Disaster, also known as the Bhopal Gas Tragedy, is recognized as the world's worst industrial disaster. The Bhopal Disaster is the only industrial disaster affecting half a million people in the last few decades. Because of the sheer magnitude of this disaster, this topic remains relevant, especially to learn what preventive measures could have been taken to ensure such a tragedy never occurred. The disaster occurred from a mixture of chemicals that produced a toxic gas, a lack of employee reporting when issues arose in the plant and weak safety systems. In December 1984, a poison gas blanketed the city of Bhopal. Due to the mistakes mentioned above, over two thousand people and many more livestock died overnight and were discovered the next morning. The effects of the disaster still linger in the same location to this day.

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Keywords

environmental disaster – Bhopal Gas Tragedy – government response – *Railway Men* – chemical disaster

1 Introduction

The Union Carbide Corporation became the first to efficiently make ethylene from natural gas. The plant produces chemicals and polymers that are raw materials for finished goods, such as paints, coatings, wires, household products, pharmaceuticals, and automotive, to name a few. The Union Carbide Corporation shined in the industry as they were known for their innovation. As they created the petrochemical industry, the Dow Jones Chemical Company decided that the Union Carbide Corporation would become a subsidiary. On August 4, 1999, the Union Carbide Company had an $11.6 billion valuation. After being purchased on February 6, 2001, the Union Carbide Corporation primarily sells raw materials for the Dow Jones Chemical Company.[1]

On December 2 and December 3rd nights, forty-two tons of Methyl Isocyanate (MIC) spilled into a nearby water source (Browning 1993). On the morning of December 3, residents in the nearby village awoke to cough, choking, and rubbing their eyes painfully. At temperatures below 39 °C, the fluid is extremely flammable and colorless. When exposed to air, the liquid quickly evaporates into the air. The fluid has an intense smell, however, and most people should be able to smell it in minimal concentrations in the air. There are multiple ways to encounter the substance, but inhalation is the most common interaction method. The vapors of this gas are severely corrosive to the respiratory tract. Some symptoms include chest pain, coughing, coma, and even death. These signs can be seen in a few hours after inhalation. Children are especially susceptible to respiratory conditions as their respiratory tracts are narrower and take in more air. Another method of encountering MIC is via ophthalmic contact. Some symptoms of eye contact with this fluid can be eye pain, tearing up, sensitivity to light, and temporary or permanent blindness.

This industrial event was the worst history had seen. Many of the victims of the Bhopal Gas Tragedy suffered eye damage, and many died within hours of inhalation of MIC, if not during the night. More than 3,800 people died during this disaster, and more than half a million people were exposed to the gas. To

1 https://www.unioncarbide.com/about-us.html (accessed Nov 1, 2023).

ensure such a large-scale tragedy does not occur like this again, we must learn about the causes as well as the safety measures.

2 Discussion

The Union Carbide India Limited was a diversified manufacturing company incorporated in 1934. It was part of the Union Carbide Corporation, one of the first US companies to invest in India. Union Carbide India Limited employed 9,000 people at its peak. The plant was built in Madhya Pradesh, a central Indian state, in Bhopal. In 1979, the main plant added a production facility. The plant and facility's main task was to create pesticides for India's agricultural sector and to increase the sector's productivity. India remains one of the most densely populated regions, and a plant was needed to meet the food needs of the developing country.

3 Context

Moments before the tragedy, an employee had malicious intent and wanted to ruin a batch of MIC (Browning 1993). There is speculation about the actual motive of this employee; the courts blamed the disaster on the whole company, not just the employee. The employee added water to a storage tank containing the MIC, causing it to vaporize quickly into the air. Around this time, all skilled supervisors were resting at home. At midnight, pressure and heat built up in an underground storage tank housing the gaseous MIC. Low-level maintenance workers did not know how to depressurize the container to prevent gas leakage. The pressure builds until the gas spills and leaks into a secondary underground storage tank designed to neutralize poisons. The container is overwhelmed by the amount of toxic gas and is forced to vent the gas into the air. Since this gas is denser than air, the vapors settle close to the ground and surround the houses and huts. An hour passed before a qualified supervisor came from home and stopped the leak. Unfortunately, by then, the damage is done.[2]

2 https://www.youtube.com/watch?v=sMHmy-95MrI (accessed Nov 10, 2023).

4 Plant History

In the 1970s, the Indian Government incentivized foreign companies to invest in India. The Union Carbide Corporation was requested to build a plant to manufacture a pesticide called Sevin. The company chose the city of Bhopal as the best location to build the plant due to its central location in India and quick access to transportation infrastructure. However, the area used in Bhopal was not for hazardous materials but only for light industrial use. Initially, the plant only created pesticides from imported chemicals. However, the plant implemented more hazardous techniques to create pesticides efficiently due to severe competition. The plant did not have adequate safety measures from its inauguration and continued to run below the safety standards of its sister plant in West Virginia, USA. Although the local government knew about the lack of safety, the government feared that heavy regulation of the plant would mean losing the employer and monetary gain from the plant (Broughton 2005). The local government decided to risk the safety of the workers and the neighboring residents.

5 Gas Specifications

MIC (C_2H_3NO) is a colorless, poisonous, and flammable liquid. Its melting point is at –45 °C, and its boiling point is at 38.3 °C. It has a sharp odor and is noticeable at 2.1 ppm; it is soluble in water (6 to 10 % at 15 °C). The primary process of creating MIC involves a monomethyl amine and phosgene reaction. Combining the reactants at an elevated temperature in their gaseous phase is best to produce substantial amounts of this reactant. During this reaction, hydrogen chloride gas is formed as a byproduct.[3] The primary use case for this gas is to produce carbamate pesticides. MIC is so lethal that just a 52-milligram dose can kill a rat immediately. For humans, the maximum amount a person should ever encounter is .02 parts per million (.02 ppm) in the air. If a person is in an area of three ppm or higher, he or she is in immediate danger and should seek medical attention.

The National Fire Protection Association has a system that rates a fluid based on four categories. They are flammability, health, instability/reactivity, and special notice. The four category ranges are from 0 to 4. The four categories, as well as the numbers, are represented in a diamond. The flammable category is

3 https://www.cdc.gov/niosh/npg/npgd0423.html (accessed Nov 20, 2023).

FIGURE 1
The four fluid categories of the National Fire Protection Association

represented in a red color. The health category is represented in a blue color. The instability/reactivity category is represented in a yellow category. The special notice category is represented in white. The gaseous form of MIC has an NFPA 704 diamond of three in the flammable category, four in the health category, three in the instability/reactivity category, and ₩ in the special notice category. ₩ means the substance is reactive to water unusually or dangerously.

When the gas was released in Bhopal, India, the primary cause of death was pulmonary edema, which is a common health hazard if MIC is inhaled. Other common symptoms include bronchitis and bronchial pneumonia. Surprisingly, a large number of survivors after the Bhopal incident had reproductive disorders (Broughton 2005). These disorders include leukorrhea, pelvic inflammation, excessive menstrual bleeding, and inability to lactate. Other diseases were stillbirths, spontaneous abortions, and an increase in infant mortality (Broughton 2005).

6 Financial Repercussions

Following the tragic event, Union Carbide India Limited had to pay for their negligence to the people of Bhopal. In 1985, the Indian Government allowed itself to represent the people of Bhopal in legal proceedings (Broughton 2005). Initially, the fines for the company ranged between $5 million and $10 million to immediately help in disaster relief via the Red Cross. The overseeing judge mentioned that doing so would not admit fault in the case. The Indian government rejected the offer as it sought to fight till a guilty verdict was reached against the company. In 1986, a figure of $350 million was reached. The figure would generate funds for the victims in Bhopal over the next few decades. The Indian Government thought this figure was too small and readjusted the settlement figure to US $3.3 billion for the victims over the next few decades. At this point, the Supreme Court of India did not want back-and-forth retorts, so they urged the Indian Government to make amends with the US. An out-of-court agreement was made in 1989, and Union Carbide agreed to pay the US $470 million immediately to the victims in Bhopal (Broughton 2005).

The Indian Supreme Court also ordered the Indian Government to purchase a group insurance plan out of that $470 million for one hundred thousand peo-

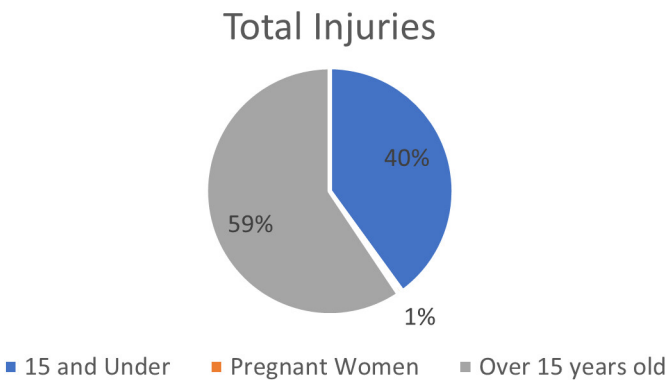

FIGURE 2 Injuries in different age groups

ple who might develop symptoms later (Broughton 2005). These treatments would take place at a Union Carbide India Limited-funded hospital, costing them an additional $17 million.

7 Effects on the People

Long after the disaster, the Indian Council of Medical Research could not publish health statistics until 1994 (Broughton 2005). After this ban on publishing data, the figures were released. The council found that over half a million people were affected by gas. From this group, there were over 200,000 people younger than 15 years old. Around 3,000 pregnant women were also considered gas-affected (Broughton 2005). However, there were some discrepancies with the death toll statistic, as many sources claim different numbers. The government of Madhya Pradesh claims the official death toll was 3,787 (Broughton 2005). Later, in 2006, the number affected by the gas grew by almost 200,000 people, and figures on injuries were also released. A statement of facts released by the government of Madhya Pradesh claimed that the gas leak caused 558,125 injuries, 38,478 partial injuries, and 3,900 severe injuries[4] [9].

A long-term study was done by sampling the affected people and any symptoms they faced immediately after the gas leak or any symptoms that developed sometime after the gas leak. The studies found long-term health effects were injuries to the eyes, respiratory tracts, neurological system, children, and devel-

4 web.archive.org/web/20100624104141/http://www.first14.com/bhopal-gas-tragedy-92-injuries-termed-minor-822.html (accessed Aug 3, 2023).

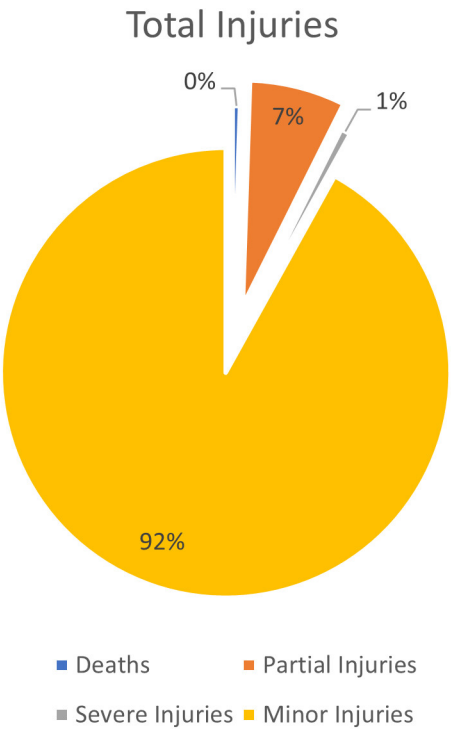

FIGURE 3 Types of injuries

opment of psychological issues (Broughton 2005). Many symptoms of the neurological problems included memory impairment and loss of fine motor skills. Many developed psychological problems, such as post-traumatic stress disorder. Children were unable to grow physically as well as intellectually. Newborn and fetal death rates increased as well.

8 Present-Day Bhopal

Health issues still plague the city decades later, especially near the once-operational plant. According to a private study, the waste stored inside the Union Carbide India Limited campus had a pesticide concentration as high as 9867 ppm (Johnson et al. 2009). The water within the factory had an above-average pesticide content, which was .28 ppm (ibid), the highest pesticide concentration in any water source nearby. All the soil that the Union Carbide India Limited company was on was found to have pesticides and traces of heavy metals (ibid). In all the water samples the study assessed, the concentration of

pesticides was 1.1 to 59.3 times the maximum concentration of pesticide water (ibid). The average concentration of pesticides in groundwater was .006 ppm, twelve times the maximum concentration groundwater should have. Finding pesticides on land is not as bad as finding them in groundwater, as the pesticides are used in the environment (ibid). However, pesticides are not used in water reservoirs, and finding pesticides in the water supply proves that the decommissioned plant is still a source of water contamination (ibid). Nearby villages still have contaminated wells as the groundwater has not been purified, and people will continue seeing adverse health conditions as long as the water remains. Unfortunately, the government has not taken any action to clean up the original contaminated site and has just disposed of the waste from the plant.

9 *Railway Men* (2023)

As noted in Jain (2023), the 1984 Bhopal Gas Tragedy has appeared earlier in films such as *Bhopal: A Prayer for Rain* (2014) and *Bhopal Express* (1999). However, *Railway Men* (2023) seems to be the first series to focus on the staff of the Bhopal train station who rescued the victims. Its four episodes depict the events leading up to the gas leak and its aftermath. The final episodes begin with a widow whose one eye was lost due to the 1984 gas leak and whose house is for sale. In the next scene, we notice several widows with a similar plight. The timeline depicts life in 1996 when an investigative journalist visits their community—"Gas Victims Widow Colony." He learns from a widow who stopped getting her monthly pension of three hundred rupees because some received unduly more than their allocated sum. Soon, he starts coughing and covers his nose as the widow warns him that the sewage lines are open, the cholera outbreak is frequent, and the aftermaths of the gas leak persist. Some widows moved to their children's homes to live with them. Her child, meanwhile, is disabled due to, again, the gas aftermaths.

The timeline travels back to 1984 when Union Carbide tried to bribe Indian government officials to suppress the news of the gas leak. The same journalist obtained a 1982 safety report, but the UC executive rejected the report, whose preventive and corrective measures had already been taken. The next scene shows a police vehicle blown away with all its members dead, while a train engine trying to move a coach full of people would not move. However, a railway staff succeeds in slowing down the oncoming train even as the leaking gas kills him. The local railway staff sacrificed their own lives to help hundreds of Muslim pilgrims aboard the train. A Maverick railway personnel tries to drive

another train to Bhopal, and other local railway staff follow suit and send several relief trains despite the higher authorities ordering against such moves. As the credits roll, we learn that the Assistant Station Master declared dead earlier was in a coma and woke up just as he was going to be cremated. The investigative journalist foretold the gas leak and called and called the UC factory a volcano waiting to erupt. A German toxicologist arrived in Bhopal with 50,000 vials of Sodium Thiosulphate, the antidote to the deadly MIC gas, but he was asked to leave the city immediately. The message with which the series ends is, "More than 15000 people lost their lives in the Bhopal gas leak. This number would have been much higher without the courage and valour of *The Railway Men*." The camera pans over the memorial to the twenty-three such Railway Workers.

10 Conclusion

The Bhopal Gas Tragedy is an event that shook the nation. While there are multiple perspectives of the events that occurred on that fateful December night, we can agree that the events that took place were the worst history has seen in the industrial engineering industry. This event was a wake-up call to other manufacturing plants and a solid reminder to instill better safety measures in factories, ensure that a senior supervisor is always on the plant grounds, and ensure that employees are professionally trained if something similar happens.

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Filmography

Bhopal: A Prayer for Rain (Ravi Kumar, 2014, in English)
Bhopal Express (Mahesh Mathai, 1999, in Hindi)
Railway Men (Shiv Rawail, 2023, in Hindi)