The Bhopal Gas Tragedy, 1984 was a catastrophe that had no parallel in the world's industrial history. In the early morning hours of December 3, 1984, a rolling wind carried a poisonous gray cloud from the Union Carbide Plant in Bhopal, Madhya Pradesh (India). Forty tons of toxic gas (Methy-Iso-Cyanate, MIC) was accidentally released from Union Carbide's Bhopal plant, which leaked and spread throughout the city. The result was a nightmare that still has no end, residents awoke to clouds of suffocating gas and began running desperately through the dark streets, victims arrived at hospitals; breathless and blind. The lungs, brain, eyes, muscles as well as gastro-intestinal, neurological, reproductive and immune systems of those who survived were severely affected. When the sun rose the next morning, the magnitude of devastation was clear. Dead bodies of humans and animals blocked the street, leaves turned black and a smell of burning chili peppers lingered in the air. An estimated 10,000 or more people died. About 500,000 more people suffered agonizing injuries with disastrous effects of the massive poisoning. None can say if future generations will not be affected.

Factors leading to the magnitude of the gas leak include:

- **Storing MIC (methyl isocyanate) in large tanks and filling beyond recommended levels**
- **Poor maintenance after the plant ceased MIC production at the end of 1984**
- **Failure of several safety systems (due to poor maintenance)**
- **Safety systems being switched off to save money—including the MIC tank refrigeration system which could have mitigated the disaster severity**

Bhopal disaster

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‹ The template below (*Infobox event*) is being considered for merging. See templates for discussion to help reach a consensus.›

Bhopal disaster

Bhopal memorial for those killed and disabled by the 1984 toxic gas release

Date	2 December 1984–3 December 1984
Location	Bhopal, Madhya Pradesh
Coordinates	23°16′51″N 77°24′38″ECoordinates: 23°16′51″N 77°24′38″E
Also known as	Bhopal gas tragedy
Cause	Gas leak from Union Carbide India Limited storage tank
Deaths	At least 3,787; over 16,000 claimed
Injuries	At least 558,125

The **Bhopal disaster**, also referred to as the **Bhopal gas tragedy**, was a gas leak incident in India, considered the world's worst industrial disaster.[1] It occurred on the night of 2–3 December 1984 at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh. Over 500,000 people were exposed to methyl isocyanate (MIC) gas and other chemicals. The toxic substance made its way in and around the shanty towns located near the plant.[2] Estimates vary on the death toll. The official immediate death toll was 2,259. The government of Madhya Pradesh confirmed a total of 3,787 deaths related to the gas release.[3] Others estimate 8,000 died within two weeks and another 8,000 or more have since died from gas-related diseases.[4][5][6] A government affidavit in

2006 stated the leak caused 558,125 injuries including 38,478 temporary partial injuries and approximately 3,900 severely and permanently disabling injuries.[7]

The cause of the disaster remains under debate. The Indian government and local activists argue slack management and deferred maintenance created a situation where routine pipe maintenance caused a backflow of water into a MIC tank triggering the disaster. UCC contends water entered the tank through an act of sabotage.

The owner of the factory, UCIL, was majority owned by Union Carbide Corporation (UCC), with Indian Government-controlled banks and the Indian public holding a 49.1 percent stake. In 1989, UCC paid $470m ($907m in 2014 dollars) to settle litigation stemming from the disaster. In 1994, UCC sold its stake in UCIL to Eveready Industries India Limited (EIIL), which subsequently merged with McLeod Russel (India) Ltd. Eveready Industries India, Limited, ended clean-up on the site in 1998, when it terminated its 99-year lease and turned over control of the site to the state government of Madhya Pradesh. Dow Chemical Company purchased UCC in 2001, seventeen years after the disaster.

Civil and criminal cases are pending in the District Court of Bhopal, India, involving UCC and Warren Anderson, UCC CEO at the time of the disaster.[8][9] In June 2010, seven ex-employees, including the former UCIL chairman, were convicted in Bhopal of causing death by negligence and sentenced to two years imprisonment and a fine of about $2,000 each, the maximum punishment allowed by Indian law. An eighth former employee was also convicted, but died before the judgement was passed.[1]

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The pre-event phase

The UCIL factory was built in 1969 to produce the pesticide Sevin (UCC's brand name for carbaryl) using methyl isocyanate (MIC) as an intermediate.[5] A MIC production plant was added in 1979.[10][11][12] After the Bhopal plant was built, other manufacturers including Bayer produced carbaryl without MIC, though at a greater manufacturing cost. However, Bayer also used the UCC process at the chemical plant once owned by UCC at Institute, West Virginia, in the United States.[13][14]

The chemical process employed in the Bhopal plant had methylamine reacting with phosgene to form MIC, which was then reacted with 1-naphthol to form the final product, carbaryl. This "route" differed from the MIC-free routes used elsewhere, in which the same raw materials were combined in a different manufacturing order, with phosgene first reacting with naphthol to form a chloroformate ester, which was then reacted with methylamine. In the early 1980s, the demand for pesticides had fallen, but production continued, leading to build-up of stores of unused MIC.[5][13]

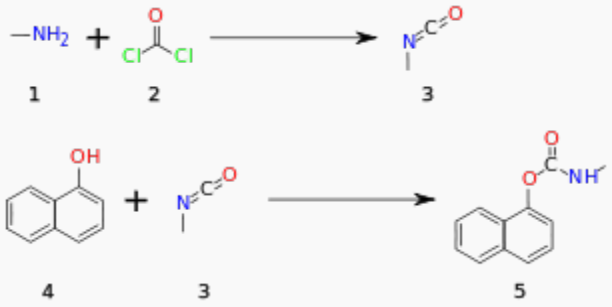
Earlier leaks

In 1976, two trade unions complained of pollution within the plant.[5][15] In 1981, a worker was splashed with phosgene. In a panic, he removed his mask, inhaling a large amount of phosgene gas which resulted in his death 72 hours later.[5][15] Local Indian authorities had warned the company of the problem as early as 1979, but constructive actions were not undertaken by UCIC at that time.[5][13] In January 1982, a phosgene leak exposed 24 workers, all of whom were admitted to a

hospital. None of the workers had been ordered to wear protective masks. One month later, in February 1982, a MIC leak affected 18 workers. In August 1982, a chemical engineer came into contact with liquid MIC, resulting in burns over 30 percent of his body. Later that same year, in October 1982, there was another MIC leak. In attempting to stop the leak, the MIC supervisor suffered severe chemical burns and two other workers were severely exposed to the gases. During 1983 and 1984, there were leaks of MIC, chlorine, monomethylamine, phosgene, and carbon tetrachloride, sometimes in combination.[5][15]

The leakage and its subsequent effects

The release



Methylamine (**1**) reacts with phosgene (**2**) producingmethyl isocyanate (**3**) which reacts with 1-naphthol (**4**) to yield carbaryl (**5**)

In November 1984, most of the safety systems were not functioning and many valves and lines were in poor condition. In addition, several vent gas scrubbers had been out of service as well as the steam boiler, intended to clean the pipes. Another issue was that Tank 610 contained 42 tons of MIC, more than safety rules allowed for.[5] During the night of 2–3 December 1984, water entered a side pipe that was missing its slip-blind plate and entered Tank E610 which contained 42 tons of MIC. A runaway reaction started, which was accelerated by contaminants, high temperatures and other factors. The reaction was sped up by the presence of iron from corroding non-stainless steel pipelines.[5] The resulting exothermic reaction increased the temperature inside the tank to over 200 °C (392 °F) and raised the pressure. This forced the emergency venting of pressure from the MIC holding tank, releasing a large volume of toxic gases. About 30 metric tons of methyl isocyanate (MIC) escaped from the tank into the atmosphere in 45 to 60 minutes.[2]

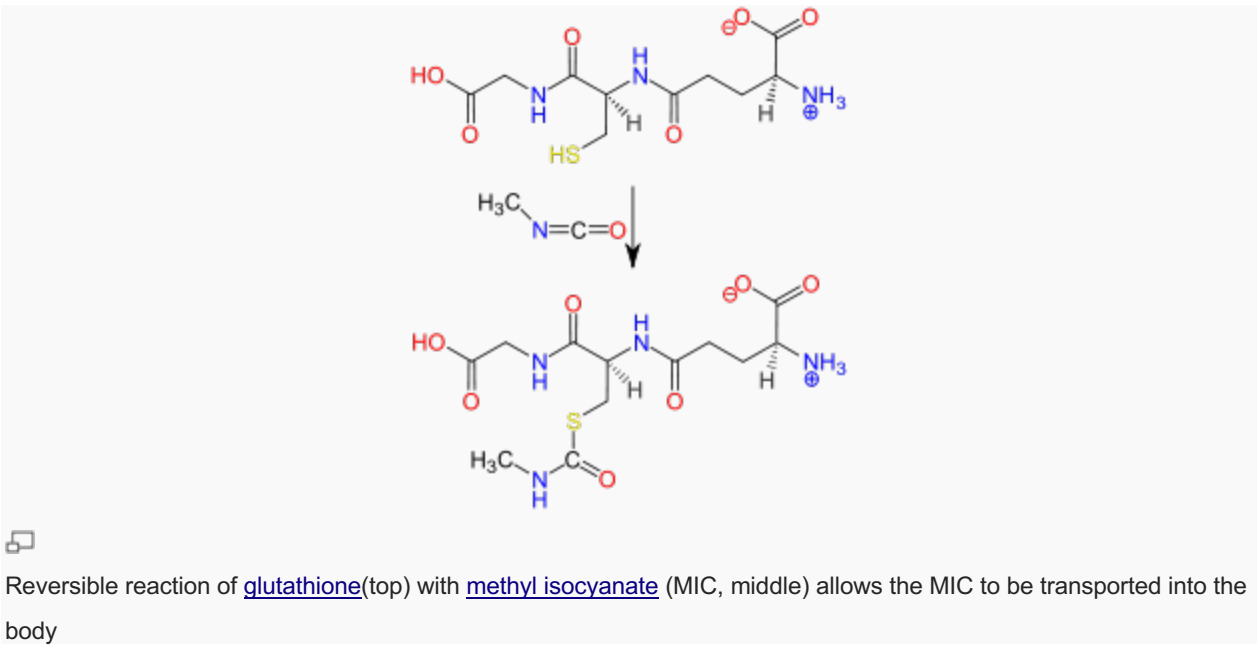
The gas cloud

The gases were blown in southeastern direction over Bhopal.[5][16]

As of 2008, UCC had not released information about the possible composition of the cloud. Apart from MIC, the gas cloud may have contained phosgene, hydrogen cyanide, carbon monoxide,hydrogen chloride, oxides of nitrogen, monomethyl amine (MMA) and carbon dioxide, either produced in the storage tank or in the atmosphere. The gas cloud was composed mainly of materials denser than the surrounding air, stayed close to the ground and spread outwards through the surrounding community.[5]

The nature of the cloud is still discussed. The chemical reactions would have produced a liquid or solid aerosol with high density. The concentrations at ground level would have been much higher than earlier published.[17]

Acute effects



Reversible reaction of glutathione(top) with methyl isocyanate (MIC, middle) allows the MIC to be transported into the body

The initial effects of exposure were coughing, severe eye irritation and a feeling of suffocation, burning in the respiratory tract, blepharospasm, breathlessness, stomach pains and vomiting. People awakened by these symptoms fled away from the plant. Those who ran inhaled more than those who had a vehicle to ride. Owing to their height, children and other people of shorter stature inhaled higher concentrations.

Thousands of people had died by the following morning.

Primary causes of deaths were choking, reflexogenic circulatory collapse and pulmonary oedema. Findings during autopsies revealed changes not only in the lungs but also cerebral oedema, tubular necrosis of the kidneys, fatty degeneration of the liver and necrotising enteritis.[18] The stillbirth rate increased by up to 300% and neonatal mortality rate by around 200%.[5]

Immediate aftermath

In the immediate aftermath, the plant was closed to outsiders (including UCC) by the Indian government, which subsequently failed to make data public, contributing to the confusion. The initial investigation was conducted entirely by the Council of Scientific and Industrial Research (CSIR) and the Central Bureau of Investigation. The UCC chairman and CEO Warren Anderson, together with a technical team, immediately traveled to India. Upon arrival, however, Anderson was placed under house arrest and urged by the Indian government to leave the country within 24 hours. Union Carbide organized a team of international medical experts, as well as supplies and equipment, to work with the local Bhopal medical community, and the UCC technical team began assessing the cause of the gas leak.

The health care system immediately became overloaded. In the severely affected areas, nearly 70 percent were underqualified doctors. Medical staff were unprepared for the thousands of casualties. Doctors and hospitals were not aware of proper treatment methods for MIC gas inhalation.[5]

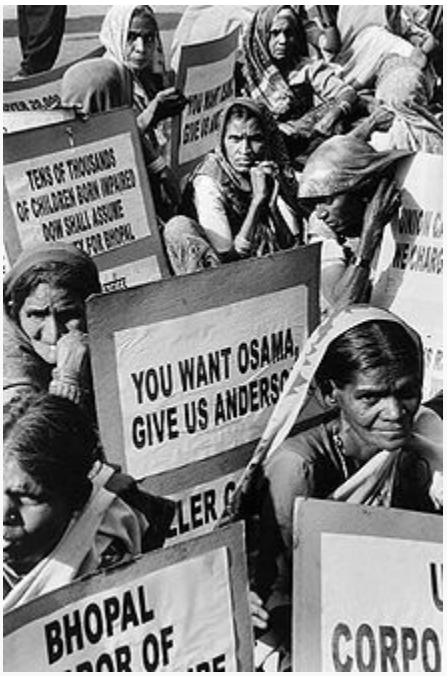
There were mass funerals and mass cremations. Bodies were dumped into the Narmada River, less than 100 km from Bhopal. Within a few days, trees in the vicinity became barren, and 2,000 bloated animal carcasses had to be disposed of. 170,000 people were treated at hospitals and temporary dispensaries. 2,000 buffalo, goats, and other animals were collected and buried. Supplies, including food, became scarce owing to suppliers' safety fears. Fishing was prohibited causing further supply shortages.[5]

Lacking any safe alternative, on 16 December, tanks 611 and 619 were emptied of the remaining MIC by reactivating the plant and continuing the manufacture of pesticide. Despite safety precautions such as covering the plant in wet hessian and having water carrying helicopters continually overflying the plant, this led to a second mass evacuation from Bhopal. The Government of India passed the "Bhopal Gas Leak Disaster Act" that gave the government rights to represent all victims, whether or not in India. Complaints of lack of information or misinformation were widespread. An Indian government spokesman said, "Carbide is more interested in getting information from us than in helping our relief work".[5]

Formal statements were issued that air, water, vegetation and foodstuffs were safe, but warned not to consume fish. The number of children exposed to the gases was at least 200,000.[5] Within weeks, the State Government established a number of hospitals, clinics and mobile units in the gas-affected area to treat the victims.

UCC established a relief fund and offered interim relief. The Indian government turned down the offer.

Subsequent legal action



Victims of Bhopal disaster asked for Warren Anderson's extradition from the USA

Legal proceedings involving UCC, the United States and Indian governments, local Bhopal authorities, and the disaster victims started immediately after the catastrophe. The Indian Government passed the Bhopal Gas Leak Act in March 1985, allowing the Government of India to act as the legal representative for victims of the disaster,[19] leading to the beginning of legal proceedings.In March 1986 UCC proposed a settlement figure, endorsed by plaintiffs' U.S. attorneys, of $350 million that would, according to the company, "generate a fund for Bhopal victims of between $500–600 million over 20 years". In May, litigation was transferred from the United States to Indian courts by U.S. District Court Judge. Following an appeal of this decision, the U.S. Court of Appeals affirmed the transfer, judging, in January 1987, that UCIL was a "separate entity, owned, managed and operated exclusively by Indian citizens in India".[19]

The Government of India refused the offer from Union Carbide and claimed US$ 3.3 billion.[5] The Indian Supreme Court told both sides to come to an agreement and "start with a clean

slate" in November 1988.[19] Eventually, in an out-of-court settlement reached in February 1989, Union Carbide agreed to pay US$470 million for damages caused in the Bhopal disaster, 15% of the original $3 billion claimed in the lawsuit.[5] The amount was immediately paid.

Throughout 1990, the Indian Supreme Court heard appeals against the settlement. In October 1991, the Supreme Court upheld the original $470 million, dismissing any other outstanding petitions that challenged the original decision. The Court ordered the Indian government "to purchase, out of settlement fund, a group medical insurance policy to cover 100,000 persons who may later develop symptoms" and cover any shortfall in the settlement fund. It also requested UCC and its subsidiary UCIL "voluntarily" fund a hospital in Bhopal, at an estimated $17 million, to specifically treat victims of the Bhopal disaster. The company agreed to this.[19]

Post-Settlement activity

In 1991, the local Bhopal authorities charged Anderson, who had retired in 1986, with manslaughter, a crime that carries a maximum penalty of 10 years in prison. He was declared a fugitive from justice by the Chief Judicial Magistrate of Bhopal on 1 February 1992 for failing to appear at the court hearings in a culpable homicide case in which he was named the chief defendant. Orders were passed to the Government of India to press for an extradition from the United States. The U.S. Supreme Court refused to hear an appeal of the decision of the lower federal courts in October 1993, meaning that victims of the Bhopal disaster could not seek damages in a U.S. court.[19]

In 2004, the Indian Supreme Court ordered the Indian government to release any remaining settlement funds to victims. And in September 2006, the Welfare Commission for Bhopal Gas Victims announced that all original compensation claims and revised petitions had been "cleared".[19] The Second Circuit Court of Appeals in New York City upheld the dismissal of remaining claims in the case of *Bano v. Union Carbide Corporation* in 2006. This move blocked plaintiffs' motions for class certification and claims for property damages and remediation. In the view of UCC, "the ruling reaffirms UCC's long-held positions and finally puts to rest—both procedurally and substantively—the issues raised in the class action complaint first filed against Union Carbide in 1999 by Haseena Bi and several organisations representing the residents of Bhopal".[19]

In June 2010, seven former employees of UCIL, all Indian nationals and many in their 70s, were convicted of causing death by negligence and each sentenced to two years imprisonment and finedRs.100,000 (US$2,124). All were released on bail shortly after the verdict. The names of those convicted are: Keshub Mahindra, former non-executive chairman of Union Carbide India Limited; V. P. Gokhale, managing director; Kishore Kamdar, vice-president; J. Mukund, works manager; S. P. Chowdhury, production manager; K. V. Shetty, plant superintendent; and S. I. Qureshi, production assistant.

Federal class action litigation, *Sahu v. Union Carbide and Warren Anderson*, sought damages for personal injury, medical monitoring and injunctive relief in the form of clean-up of the drinking water supplies for residential areas near the Bhopal plant. The lawsuit was dismissed and subsequent appeal denied.[20]

Long-term effects

Long-term health effects

Some data about the health effects are still not available. The Indian Council of Medical Research (ICMR) was forbidden to publish health effect data until 1994.[5]

A total of 36 wards were marked by the authorities as being "gas affected," affecting a population of 520,000. Of these, 200,000 were below 15 years of age, and 3,000 were pregnant women. The official immediate death toll was 2,259, and in 1991, 3,928 deaths had been officially certified. Others estimate 8,000 died within two weeks.[4][5]

The government of Madhya Pradesh confirmed a total of 3,787 deaths related to the gas release.[3]

Later, the affected area was expanded to include 700,000 citizens. A government affidavit in 2006 stated the leak caused 558,125 injuries including 38,478 temporary partial injuries and approximately 3,900 severely and permanently disabling injuries.[7]

A cohort of 80 021 exposed people was registered, along with a control group, a cohort of 15 931 people from areas not exposed to MIC. Nearly every year since 1986, they have answered the same questionnaire. It shows overmortality and overmorbidity in the exposed group.
However, bias and confounding factors cannot be excluded from the study. Because of migration and other factors, 75% of the cohort is lost, as the ones who moved out are not followed.[5][21]

A number of clinical studies are performed. The quality varies, but the different reports support each others.[5] Studied and reported long term health effects are:

- Eyes: Chronic conjunctivitis, scars on cornea, corneal opacities, early cataracts
- Respiratory tracts: Obstructive and/or restrictive disease, pulmonary fibrosis, aggravation of TB and chronic bronchitis
- Neurological system: Impairment of memory, finer motor skills, numbness etc.
- Psychological problems: Post traumatic stress disorder (PTSD)
- Children's health: Peri- and neonatal death rates increased. Failure to grow, intellectual impairment etc.

Missing or insufficient fields for research are female reproduction, chromosomal aberrations, cancer, immune deficiency, neurological sequelae, post traumatic stress disorder (PTSD) and children born after the disaster. Late cases that might never be highlighted are respiratory insufficiency, cardiac insufficiency (cor pulmonale), cancer and tuberculosis.

Health care

The Government of India had focused primarily on increasing the hospital-based services for gas victims thus hospitals had been built after the disaster. When UCC wanted to sell its shares in UCIL, it was directed by the Supreme Court to finance a 500-bed hospital for the medical care of the survivors. Thus, Bhopal Memorial Hospital and Research Centre (BMHRC) was inaugurated in 1998 and was obliged to give free care for survivors for eight years. BMHRC was a 350-bedded super speciality hospital where heart surgery and hemodialysis were done. However, there was a dearth of gynaecology, obstetrics and paediatrics. Eight mini-units (outreach health centres) were started and free health care for gas victims were to be offered till 2006.[5] The management had also faced problems with strikes, and the quality of the health care being disputed.[22][23] Sambhavna Trust is a charitable trust, registered in 1995, that gives modern as well as ayurvedic treatments to gas victims, free of charge.[5][24]

Environmental rehabilitation

When the factory was closed in 1986, pipes, drums and tanks were sold. The MIC and the Sevin plants are still there, as are storages of different residues. Isolation material is falling down and spreading.[5] The area around the plant was used as a dumping area for hazardous chemicals. In 1982 tubewells in the vicinity of the UCIL factory had to be abandoned and tests in 1989 performed by UCC's laboratory revealed that soil and water samples collected from near the factory and inside the plant were toxic to fish.[25] Several other studies had also shown polluted soil and groundwater in the area. Reported polluting compounds include 1-naphthol, naphthalene, Sevin, tarry

residue, mercury, toxic organochlorines, volatile organochlorine compounds, chromium, copper, nickel, lead,hexachloroethane, hexachlorobutadiene, and the pesticide HCH.[5]

In order to provide safe drinking water to the population around the UCIL factory, Government of Madhya Pradesh presented a scheme for improvement of water supply.[26] In December 2008, the Madhya Pradesh High Court decided that the toxic waste should be incinerated at Ankleshwar in Gujarat, which was met by protests from activists all over India.[27] On 8 June 2012, the Centre for incineration of toxic Bhopal waste agreed to pay ₹250 million (US$4.3 million) to dispose of UCIL chemical plants waste in Germany.[28] On 9 August 2012, Supreme court directed the Union and Madhya Pradesh Governments to, take immediate steps for disposal of toxic waste lying around and inside the factory within six months.[29]

A U.S. court rejected the lawsuit blaming UCC for causing soil and water pollution around the site of the plant and ruled that responsibility for remedial measures or related claims rested with the State Government and not with UCC.[30] In 2005, the state government invited various Indian architects to enter their "concept for development of a memorial complex for Bhopal gas tragedy victims at the site of Union Carbide". In 2011, a conference was held on the site, with participants from European universities which was aimed for the same.[31][32]

Occupational and habitation rehabilitation

33 of the 50 planned work-sheds for gas victims started. All except one was closed down by 1992. 1986, the MP government invested in the Special Industrial Area Bhopal. 152 of the planned 200 work sheds were built and in 2000, 16 were partially functioning. It was estimated that 50,000 persons need alternative jobs, and that less than 100 gas victims had found regular employment under the government's scheme. The government also planned 2,486 flats in two- and four-story buildings in what is called the "widow's colony" outside Bhopal. The water did not reach the upper floors and it was not possible to keep cattle which were their primary occupation. Infrastructure like buses, schools, etc. were missing for at least a decade.[5]

Economic rehabilitation

Immediate relieves were decided two days after the tragedy. Relief measures commenced in 1985 when food was distributed for a short period along with ration cards.[5] Madhya Pradesh government's finance department allocated ₹874 million (US$15 million) for victim relief in July 1985.[33][34] Widow pension of ₹200 (US$3.40)/per month (later ₹750 (US$13)) were provided. The government also decided to pay ₹1500 (US$26) to families with monthly income ₹500 (US$8.50) or less. As a result of the interim relief, more children were able to attend school, more money was spent on treatment and food, and housing also eventually improved. From 1990 interim relief of ₹200 (US$3.40) was paid to everyone in the family who was born before the disaster.[5]

The final compensation, including interim relief for personal injury was for the majority ₹25,000 (US$430). For death claim, the average sum paid out was ₹62,000 (US$1,100). Each claimant were to be categorised by a doctor. In court, the claimants were expected to prove "beyond reasonable doubt" that death or injury in each case was attributable to exposure. In 1992, 44 percent of the claimants still had to be medically examined.[5]

By the end of October 2003, according to the Bhopal Gas Tragedy Relief and Rehabilitation Department, compensation had been awarded to 554,895 people for injuries received and 15,310 survivors of those killed. The average amount to families of the dead was $2,200.[35]

In 2007, 1,029,517 cases were registered and decided. Number of awarded cases were 574,304 and number of rejected cases 455,213. Total compensation awarded was ₹15465 million(US$260 million).[26] On 24 June 2010, the Union Cabinet of the Government of India approved a ₹12650 million (US$220 million) aid package which would be funded by Indian taxpayers through the government.[36]

Other impacts

In 1985, Henry Waxman, a California Democrat, called for a U.S. government inquiry into the Bhopal disaster, which resulted in U.S. legislation regarding the accidental release of toxic chemicals in the United States.[37]

Causes of the disaster: Overview

There are two main lines of argument involving the disaster. The "Corporate Negligence" point of view argues that the disaster was caused by a potent combination of under-maintained and decaying facilities, a weak attitude towards safety, and an undertrained workforce, culminating in worker actions that inadvertently enabled water to penetrate the MIC tanks in the absence of properly working safeguards.[4][5]

The "Worker Sabotage" point of view argues that it was not physically possible for the water to enter the tank without concerted human effort, and that extensive testimony and engineering analysis leads to a conclusion that water entered the tank when a rogue individual employee hooked a water hose directly to an empty valve on the side of the tank. This point of view further argues that the Indian government took extensive actions to hide this possibility in order to attach blame to UCC.[38]

Theories differ as to how the water entered the tank. At the time, workers were cleaning out a clogged pipe with water about 400 feet from the tank. They claimed that they were not told to isolate the tank with a pipe slip-blind plate. The operators assumed that owing to bad maintenance and leaking valves, it was possible for the water to leak into the tank.[5][39]

However, this water entry route could not be reproduced despite strenuous efforts by motivated parties.[40] UCC claims that a "disgruntled worker" deliberately connecting a hose to a pressure gauge connection was the real cause.[5][38]

Early the next morning, a UCIL manager asked the instrument engineer to replace the gauge. UCIL's investigation team found no evidence of the necessary connection; however, the investigation was totally controlled by the government, denying UCC investigators access to the tank or interviews with the operators.[41][38]

Causes of the disaster: The "Corporate Negligence" Argument

This point of view argues that management (and to some extent, local government) underinvested in safety and allowed for a dangerous working environment. Factors cited include the filling of the MIC tanks beyond recommended levels, poor maintenance after the plant ceased MIC production at the end of 1984, allowing several safety systems to be inoperable due to poor maintenance, and switching off safety systems to save money— including the MIC tank refrigeration system which could have mitigated the disaster severity, and non-existent catastrophe plans.[4][5] Other factors identified by government inquiries included undersized safety devices and the dependence on manual operations.[5] Specific plant management deficiencies that were identified include the lack of skilled operators, reduction of safety management, insufficient maintenance, and inadequate emergency action plans.[5][15]

Underinvestment

Underinvestment is cited as contributing to an environment. Attempts to reduce expenses affected the factory's employees and their conditions. Kurzman argues that "cuts ... meant less stringent quality control and thus looser safety rules. A pipe leaked? Don't replace it, employees said they were told ... MIC workers needed more training? They could do with less. Promotions were halted, seriously affecting employee morale and driving some of the most skilled ... elsewhere".[42] Workers were forced to use English manuals, even though only a few had a grasp of the language.[39][43]

Subsequent research highlights a gradual deterioration of safety practices in regard to the MIC, which had become less relevant to plant operations. By 1984, only six of the original twelve operators were still working with MIC and the number of supervisory personnel had also been halved. No maintenance supervisor was placed on the night shift and instrument readings were taken every two hours, rather than the previous and required one-hour readings.[42][39] Workers made complaints about the cuts through their union but were ignored. One employee was fired after going on a 15-day hunger strike. 70% of the plant's employees were fined before the disaster for refusing to deviate from the proper safety regulations under pressure from the management.[42][39]

In addition, some observers, such as those writing in the Trade Environmental Database (TED) Case Studies as part of the Mandala Project from American University, have pointed to "serious communication problems and management gaps between Union Carbide and its Indian operation", characterised by "the parent companies [*sic*] hands-off approach to its overseas operation" and "cross-cultural barriers".[44]

Adequacy of Equipment and safety regulations

The factory was not well equipped to handle the gas created by the sudden addition of water to the MIC tank. The MIC tank alarms had not been working for four years and there was only one manual back-up system, compared to a four-stage system used in the United States.[4][5][39][45] The flare tower and several vent gas scrubbers had been out of service for five months before the disaster. Only one gas scrubber was operating: it could not treat such a large amount of MIC with sodium hydroxide (caustic soda), which would have brought the concentration down to a safe level.[45] The flare tower could only handle a quarter of the gas that leaked in 1984, and moreover it was out of order at the time of the incident.[4][5][39][46] To reduce energy costs, the refrigeration system was idle. The MIC was kept at 20 degrees Celsius, not the 4.5 degrees advised by the manual.[4][5][39][45] Even the steam boiler, intended to clean the pipes, was non-operational for unknown reasons.[4][5][39][45]Slip-blind plates that would have prevented water from pipes being cleaned from leaking into the MIC tanks, had the valves been faulty, were not installed and their installation had been omitted from the cleaning checklist.[4][5][39] As MIC is water soluble, deluge guns were in place to contain escaping gases from the stack. However, the water pressure was too weak for the guns to spray high enough to reach the gas which would have reduced the concentration of escaping gas significantly.[4][5][39][45] In addition to it, carbon steel valves were used at the factory, even though they were known to corrode when exposed to acid.[13]

According to the operators, the MIC tank pressure gauge had been malfunctioning for roughly a week. Other tanks were used, rather than repairing the gauge. The build-up in temperature and pressure is believed to have affected the magnitude of the gas release.[4][5][39][45] UCC admitted in their own investigation report that most of the safety systems were not functioning on the night of 3 December 1984.[47] The design of the MIC plant, following government guidelines, was "Indianized" by UCIL engineers to maximise the use of indigenous materials and products. Mumbai-based Humphreys and Glasgow Consultants Pvt. Ltd., were the main consultants, Larsen & Toubro fabricated the MIC storage tanks, and Taylor of India Ltd. provided the instrumentation.[48] In 1998, during civil action suits in India, it emerged that the plant was not prepared for problems. No action plans had been established to cope with incidents of this magnitude. This included not informing local authorities of the quantities or dangers of chemicals used and manufactured at Bhopal.[4][5][13][39]

Safety audits

Safety audits were done every year in the US and European UCC plants, but only every two years in other parts of the world.[5][49] Before a "Business Confidential" safety audit by UCC in May 1982, the senior officials of the corporation were well aware of "a total of 61 hazards, 30 of them major and 11 minor in the dangerous phosgene/methyl isocyanate units" in Bhopal.[5][50] In the audit 1982, it was indicated that worker performance was below standards.[5][41] Ten major concerns were listed.[5] UCIL prepared an action plan, but UCC never sent a follow-up team to Bhopal. Many of the

items in the 1982 report were temporarily fixed, but by 1984, conditions had again deteriorated.[41] In September 1984, an internal UCC report on the Virginia plant in the USA revealed a number of defects and malfunctions. It warned that "a runaway reaction could occur in the MIC unit storage tanks, and that the planned response would not be timely or effective enough to prevent catastrophic failure of the tanks". This report was never forwarded to the Bhopal plant, although the main design was the same.[51]

Causes of the Disaster: The "Disgruntled Employee Sabotage" Case

Now owned by Dow Chemical Company, Union Carbide maintains a website dedicated to the tragedy and claims that the incident was the result of sabotage, stating that sufficient safety systems were in place and operative to prevent the intrusion of water.[52]

The impossibility of the "Negligence" argument

According to the "Corporate Negligence" argument, workers had been cleaning out pipes with water nearby. This water was diverted due to a combination of improper maintenance, leaking and clogging, and eventually ended up in the MIC storage tank. Indian scientists also suggested that additional water might have been introduced as a "back-flow" from a defectively designed vent-gas scrubber. However, none of these theoretical routes of entry were ever successfully demonstrated during tests by the Central Bureau of Investigators (CBI) and UCIL engineers.[39][49][41][53]

An analysis by Arthur Little argues that the Negligence argument was impossible for several tangible reasons:[38]

1. The pipes being used by the nearby workers were only 1/2 inch in diameter and were physically incapable of producing enough hydraulic pressure to raise water the more than 10 feet that would have been necessary to enable the water to "backflow" into the MIC tank.
2. A key intermediate valve would have had to be open for the Negligence argument to apply. However, this valve was "tagged" closed, meaning that it had been inspected and found to be closed. While it is possible for open valves to clog over time, the only way a closed valve allows penetration is if there is leakage, and 1985 tests carried out by the government of India found this valve to be non-leaking.
3. In order for water to have reached the MIC tank from the pipe-cleaning area, it would have had to flow through a significant network of pipes ranging from 6 to 8 inches in diameter, before rising ten feet and flowing into the MIC tank. Had this occurred, most of the water that was in those pipes at the time the tank had its critical reaction would have remained in those pipes, as there was no drain for them. However, investigation by the Indian government in 1985 revealed that the pipes were bone dry.

The argument for sabotage

The Little report concludes that a single employee secretly and deliberately introduced a large amount of water into the MIC tank by removing a meter and connecting a water hose directly to the tank through the metering port.[38]

UCC claims the plant staff falsified numerous records to distance themselves from the incident and absolve themselves of blame, and that the Indian Government impeded its investigation and

declined to prosecute the employee responsible, presumably because that would weaken its allegations of negligence by Union Carbide.[54]

The evidence in favor of this point of view includes:

1. A key witness (the "tea boy") testified that when he entered the control room at 12:15am, prior to the disaster, the "atmosphere was tense and quiet".
2. Another key witness (the "instrument supervisor") testified that when he arrived at the scene immediately following the incident, he noticed that the local pressure indicator on the critical Tank 610 was missing, and that he had found a hose lying next to the empty manhead created by the missing pressure indicator, and that the hose had had water running out of it.
3. This testimony was corroborated by other witnesses.
4. Graphological analysis revealed major attempts to alter logfiles and destroy log evidence.
5. Other logfiles show that the control team had attempted to purge 1 ton of material out of Tank 610 immediately prior to the disaster. An attempt was then made to cover up this transfer via log alteration. Water is heavier than MIC, and the transfer line is attached to the bottom of the tank. The Little report concludes from this that the transfer was an effort to transfer water out of Tank 610 that had been discovered there.
6. A third key witness (the "off-duty employee of another unit") stated that "he had been told by a close friend of one of the MIC operators that water had entereed through a tube that had been connected to the tank." This had been discovered by the other MIC operators (so the story was recounted) who then tried to open and close valves to prevent the release.
7. A fourth key witness (the "operator from a different unit") stated that after the release, two MIC operators had told him that water had entered the tank through a pressure gauge.

The Little report argues that this evidence demonstrates that the following chronology actually took place:

- At 10:20pm, the tank was at normal pressure, indicating the absence of water.
- At 10:45pm, a shift change took change, during which time the MIC storage area "would be completely deserted".
- During this period, a "disgruntled operator entered the storage area and hooked up one of the readily available rubber water hoses to Tank 610, with the intention of contaminating and spoiling the tank's contents."
- Water began to flow, beginning the chemical reaction that caused the disaster.

- After midnight, control room operators saw the pressure rising and realized there was a problem with Tank 610. They discovered the water connection, and decided to transfer one ton of the contents out to try and remove the water.
- The disaster then occurred, a major release of poisonous gas.
- The cover-up activities discovered during the investigation then took place.

Additional Union Carbide Actions

The corporation denied the claim that the valves on the tank were malfunctioning, and claimed that the documented evidence gathered after the incident showed that the valve close to the plant's water-washing operation was closed and was leak-tight. Furthermore, process safety systems had prevented water from entering the tank by accident. Carbide states that the safety concerns identified in 1982 were all allayed before 1984 and had nothing to do with the incident.[55]

The company admitted that the safety systems in place would not have been able to prevent a chemical reaction of that magnitude from causing a leak. According to Carbide, "in designing the plant's safety systems, a chemical reaction of this magnitude was not factored in" because "the tank's gas storage system was designed to automatically prevent such a large amount of water from being inadvertently introduced into the system" and "process safety systems—in place and operational—would have prevented water from entering the tank by accident". Instead, they claim that "employee sabotage—not faulty design or operation—was the cause of the tragedy".[55]

Tactical Response

The company stresses the immediate action taken after the disaster and its continued commitment to helping the victims. On 4 December, the day following the leak, Union Carbide sent material aid and several international medical experts to assist the medical facilities in Bhopal.[55]

Financial Response

The primary financial restitution paid by UCC was negotiated in 1989, when the Indian Supreme Court approved a settlement of US$470 million (Rs 7.52 billion, equivalent to $907 million in 2014 dollars, and RS 55.42 billion in 2014 rupees). This amount was immediately paid by UCC to the Indian government. The company states that the restitution paid "was $120 million more than plaintiffs' lawyers had told U.S. courts was fair" and that the Indian Supreme Court stated in its opinion that "compensation levels under the settlement were far greater than would normally be payable under Indian law."[56]

In the immediate aftermath of the disaster, Union Carbide states on its website that it put $2 million into the Indian prime minister's immediate disaster relief fund on 11 December 1984.[55] The corporation established the Employees' Bhopal Relief Fund in February 1985, which raised more than $5 million for immediate relief.[19] According to Union Carbide, in August 1987, they made an additional $4.6 million in humanitarian interim relief available.[19]

Union Carbide stated that it also undertook several steps to provide continuing aid to the victims of the Bhopal disaster. The sale of its 50.9 percent interest in UCIL in April 1992 and establishment of a charitable trust to contribute to the building of a local hospital. The sale was finalised in November 1994. The hospital was begun in October 1995 and was opened in 2001. The company provided a fund with around $90 million from sale of its UCIL stock. In 1991, the trust had amounted approximately $100 million. The hospital catered for the treatment of heart, lung and eye problems.[52] UCC also provided a $2.2 million grant to Arizona State University to establish a vocational-technical center in Bhopal, which was opened, but was later closed by the state government.[56] They also donated $5 million to the Indian Red Cross after the disaster.[56] They also

developed a Responsible Care system with other members of the chemical industry as a response to the Bhopal crisis, which was designed to help prevent such an event in the future.[19]

Charges against UCC and UCIL employees

UCC chairman and CEO Warren Anderson was arrested and released on bail by the Madhya Pradesh Police in Bhopal on 7 December 1984. Anderson was taken to UCC's house after which he was released six hours later on $2,100 bail and flown out on a government plane. These actions were allegedly taken under the direction of then chief secretary of the state, who was possibly instructed from chief minister's office, who himself flew out of Bhopal immediately.[57][58][59] Later in 1987, the Indian government summoned Anderson, eight other executives and two company affiliates withhomicide charges to appear in Indian court.[60] In response, Union Carbide balked, saying the company is not under Indian jurisdiction.[60]

Ongoing contamination

Deteriorating portion of the MIC plant, decades after the gas leak. Contributor to ongoing contamination.

Chemicals abandoned at the plant continue to leak and pollute the groundwater.[35][61][62][63] Whether the chemicals pose a health hazard is disputed.[64] Contamination at the site and surrounding area was not caused by the gas leakage. The area around the plant was used as a dumping ground for hazardous chemicals and by 1982 water wells in the vicinity of the UCIL factory had to be abandoned.[5] UCC states that "after the incident, UCIL began clean-up work at the site under the direction of Indian central and state government authorities", which was continued after 1994 by the successor to UCIL. The successor, Eveready Industries India, Limited (EIIL), ended cleanup on the site in 1998, when it terminated its 99-year lease and turned over control of the site to the state government of Madhya Pradesh.[52][19]

UCC's laboratory tests in 1989 revealed that soil and water samples collected from near the factory were toxic to fish. Twenty-one areas inside the plant were reported to be highly polluted. In 1991 the municipal authorities declared that water from over 100 wells was hazardous for health if used for drinking.[5] In 1994 it was reported that 21% of the factory premises were seriously contaminated with chemicals.[25][65][66] Beginning in 1999, studies made by Greenpeace and others from soil, groundwater, wellwater and vegetables from the residential areas around UCIL and from the UCIL factory area show contamination with a range of toxic heavy metals and chemical compounds. Substances found, according to the reports, are naphthol, naphthalene, Sevin, tarry residues, alpha naphthol, mercury, organochlorines, chromium, copper, nickel, lead, hexachlorethane, hexachlorobutadiene, pesticide HCH (BHC), volatile organic compounds and halo-organics.[65][66][67][68] Many of these contaminants were also found in breast milk of women living near the area.[69] Soil tests were conducted by Greenpeace in 1999. One sample (IT9012) from "sediment

collected from drain under former Sevin plant" showed mercury levels to be at "20,000 and 6 million times" higher than expected levels. Organochlorine compounds at elevated levels were also present in groundwater collected from (sample IT9040) a 4.4 meter depth "bore-hole within the former UCIL site". This sample was obtained from a source posted with a warning sign which read "Water unfit for consumption".[70]Chemicals that have been linked to various forms of cancer were also discovered, as well as trichloroethylene, known to impair fetal development, at 50 times above safety limits specified by the U.S. Environmental Protection Agency (EPA).[69] In 2002, an inquiry by Fact-Finding Mission on Bhopal found a number of toxins, including mercury, lead, 1,3,5 trichlorobenzene, dichloromethane andchloroform, in nursing women's breast milk.

A 2004 BBC Radio 5 broadcast reported the site is contaminated with toxic chemicals including benzene hexachloride and mercury, held in open containers or loose on the ground.[71] A drinking water sample from a well near the site had levels of contamination 500 times higher than the maximum limits recommended by the World Health Organization.[72] In 2009, the Centre for Science and Environment, a Delhi-based pollution monitoring lab, released test results showing pesticide groundwater contamination up to three kilometres from the factory.[73] Also in 2009, the BBC took a water sample from a frequently used hand pump, located just north of the plant. The sample, tested in UK, was found to contain 1,000 times the World Health Organization's recommended maximum amount of carbon tetrachloride, a carcinogenic toxin.[74] In October 2011, the Institute of Environmental Management and Assessment published an article and video by two British environmental scientists, showing the current state of the plant, landfill and solar evaporation ponds and calling for renewed international efforts to provide the necessary skills to clean up the site and contaminated groundwater.[75]

Activism

Since 1984, individual activists have played a role in the aftermath of the tragedy. The best-known is Satinath Sarangi (Sathyu), a metallurgic engineer who arrived at Bhopal the day after the leakage. He founded several activist groups, as well as Sambhavna Trust, the clinic for gas affected patients, where he is the manager.[5] Other activists include Rashida Bee and Champa Devi Shukla, who received the Goldman Prize in 2004, Abdul Jabbar and Rachna Dhingra.[76][77]

Local activism

Soon after the accident, representatives from different activist groups arrived. The activists worked on organising the gas victims, which led to violent repression from the police and the government.[5]

Numerous actions have been performed: demonstrations, sit-ins, hunger strikes, marches combined with pamphlets, books, and articles. Every anniversary, actions are performed. Often these include marches around Old Bhopal, ending with burning an effigy of Warren Anderson.

International activism

Cooperation with international NGOs including Pesticide Action Network UK and Greenpeace started soon after the tragedy. One of the earliest reports is the Trade Union report from ILO 1985.[41]

In 1994, the International Medical Commission on Bhopal (IMCB) met in Bhopal. Their work contributed to long term health effects being officially recognised.

Important international actions have been the tour to Europe and United States in 2003,[78] the marches to Delhi in 2006 and 2008, all including hunger strikes, and the Bhopal Europe Bus Tour in 2009.

Activist organisations

At least 14 different NGOs were immediately engaged.[5] The first disaster reports were published by activist organisations, Eklavya and the Delhi Science Forum.

Around ten local organisations, engaged on long term, have been identified. Two of the most active organisations are the women's organisations—Bhopal Gas Peedit Mahila-Stationery Karmachari Sangh and Bhopal Gas Peedit Mahila Udyog Sangthan.[5]

More than 15 national organisations have been engaged along with a number of international organisations.[5]

Some of the most important organisations are:

- International Campaign For Justice in Bhopal (ICJB) Coordinating international activities.
- Bhopal Medical Appeal Collects funds for the Sambhavna Trust.
- Sambhavna Trust or Bhopal People's Health and Documentation Clinic. Provides medical care for gas affected patients and those living in water-contaminated area.
- Chingari Trust Provides medical care for children being born in Bhopal with malformations and brain damages.
- Students for Bhopal Based in USA.
- International Medical Commission on Bhopal Provided medical information 1994–2000.

Settlement fund hoax

Bichlbaum as Finisterra on BBC World News

On 3 December 2004, the twentieth anniversary of the disaster, a man claiming to be a Dow representative named Jude Finisterra was interviewed on BBC World News. He claimed that the company had agreed to clean up the site and compensate those harmed in the incident, by liquidating Union Carbide forUS$12 billion.[79][80] Immediately afterward, Dow's share price fell 4.2% in 23 minutes, for a loss of $2 billion in market value. Dow quickly issued a statement saying that they had no employee by that name—that he was an impostor, not affiliated with Dow, and that his claims were a hoax. The BBC later broadcast a correction and an apology.[81]

Jude Finisterra was actually Andy Bichlbaum, a member of the activist prankster group The Yes Men. In 2002, The Yes Men issued a fake press release explaining why Dow refused to take responsibility for the disaster and started up a website, at "DowEthics.com", designed to look like the real Dow website, but with what they felt was a more accurate cast on the events.[82]

Monitoring of Bhopal activists

A release of an email cache related to intelligence research organisation Stratfor was leaked by WikiLeaks on 27 February 2012.[83] It revealed that Dow Chemical had engaged Stratfor to spy on the public and personal lives of activists involved in the Bhopal disaster, including the Yes Men.

Regular, even daily emails to Dow representatives from hired security analysts list the YouTube videos liked, Twitter and Facebook posts made and the public appearances of these activists.[84] Stratfor released a statement condemning the revelation by Wikileaks while neither confirming nor denying the accuracy of the reports, and would only state that it had acted within the bounds of the law. Dow Chemical also refrained to comment on the matter.[85]

Ingrid Eckerman, a Swedish family physician and a member of the International Medical Commission on Bhopal in 1994, published *The Bhopal Saga: Causes and Consequences of the World's Largest Industrial Disaster* in 2004.[5] Since 2008 she has been denied a visa to visit India.[86]

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Abstract

December 2004 marked the twentieth anniversary of the massive toxic gas leak from Union Carbide Corporation's chemical plant in Bhopal in the state of Madhya Pradesh, India that killed more than 3,800 people. This review examines the health effects of exposure to the disaster, the legal response, the lessons learned and whether or not these are put into practice in India in terms of industrial development, environmental management and public health.

Go to:

History

In the 1970s, the Indian government initiated policies to encourage foreign companies to invest in local industry. Union Carbide Corporation (UCC) was asked to build a plant for the manufacture of Sevin, a pesticide commonly used throughout Asia. As part of the deal, India's government insisted that a significant percentage of the investment come from local shareholders. The government itself had a 22% stake in the company's subsidiary, Union Carbide India Limited (UCIL) [1]. The company built the plant in Bhopal because of its central location and access to transport infrastructure. The specific site within the city was zoned for light industrial and commercial use, not for hazardous industry. The plant was initially approved only for formulation of pesticides from component chemicals, such as MIC imported from the parent company, in relatively small quantities. However, pressure from competition in the chemical industry led UCIL to implement "backward integration" – the manufacture of raw materials and intermediate products for formulation of the final product within one facility. This was inherently a more sophisticated and hazardous process [2].

In 1984, the plant was manufacturing Sevin at one quarter of its production capacity due to decreased demand for pesticides. Widespread crop failures and famine on the subcontinent in the 1980s led to increased indebtedness and decreased capital for farmers to invest in pesticides. Local managers were directed to close the plant and prepare it for sale in July 1984 due to decreased profitability [3]. When no ready buyer was found, UCIL made plans to dismantle key production units of the facility for shipment to another developing country. In the meantime, the facility continued to operate with safety equipment and procedures far below the standards found in its sister plant in Institute, West Virginia. The local government was aware of safety problems but was reticent to place heavy industrial safety and pollution control burdens on the struggling industry because it feared the economic effects of the loss of such a large employer [3].

At 11.00 PM on December 2 1984, while most of the one million residents of Bhopal slept, an operator at the plant noticed a small leak of methyl isocyanate (MIC) gas and increasing pressure inside a storage tank. The vent-gas scrubber, a safety device designer to neutralize toxic discharge from the MIC system, had been turned off three weeks prior [3]. Apparently a faulty valve had allowed one ton of water for cleaning internal pipes to mix with forty tons of MIC [1]. A 30 ton refrigeration unit that normally served as a safety component to cool the MIC storage tank had been drained of its coolant for use in another part of the plant [3]. Pressure and heat from the vigorous exothermic reaction in the tank continued to build. The gas flare safety system was out of action and had been for three months. At around 1.00 AM, December 3, loud rumbling reverberated around the plant as a safety valve gave way sending a plume of MIC gas into the early morning air [4]. Within hours, the streets of Bhopal were littered with human corpses and the carcasses of buffaloes, cows, dogs and birds. An estimated 3,800 people died immediately, mostly in the poor slum colony adjacent to the UCC plant [1,5]. Local hospitals were soon overwhelmed with the injured, a crisis further compounded by a lack of knowledge of exactly what gas was involved and what its effects were [1]. It became one of the worst chemical disasters in history and the name Bhopal became synonymous with industrial catastrophe [5].

Estimates of the number of people killed in the first few days by the plume from the UCC plant run as high as 10,000, with 15,000 to 20,000 premature deaths reportedly occurring in the subsequent two decades [6]. The Indian government reported that more than half a million people were exposed to the gas [7]. Several epidemiological studies conducted soon after the accident showed significant morbidity and increased mortality in the exposed

population. Table Table1.1. summarizes early and late effects on health. These data are likely to under-represent the true extent of adverse health effects because many exposed individuals left Bhopal immediately following the disaster never to return and were therefore lost to follow-up [8].

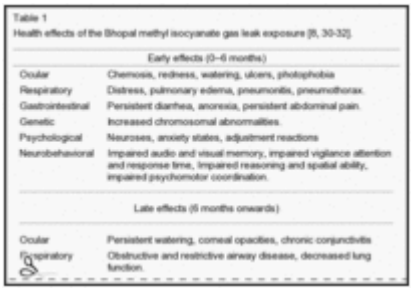

Table 1

Health effects of the Bhopal methyl isocyanate gas leak exposure [8, 30-32].

Early effects (0–6 months)	
Ocular	Chemosis, redness, watering, ulcers, photophobia
Respiratory	Distress, pulmonary edema, pneumonitis, pneumothorax.
Gastrointestinal	Persistent diarrhea, anorexia, persistent abdominal pain.
Genetic	Increased chromosomal abnormalities.
Psychological	Neuroses, anxiety states, adjustment reactions
Neurobehavioral	Impaired audio and visual memory, impaired vigilance attention and response time, impaired reasoning and spatial ability, impaired psychomotor coordination.
Late effects (6 months onwards)	
Ocular	Persistent watering, corneal opacities, chronic conjunctivitis
Respiratory	Obstructive and restrictive airway disease, decreased lung function.

Go to:

Aftermath

Immediately after the disaster, UCC began attempts to dissociate itself from responsibility for the gas leak. Its principal tactic was to shift culpability to UCIL, stating the plant was wholly built and operated by the Indian subsidiary. It also fabricated scenarios involving sabotage by previously unknown Sikh extremist groups and disgruntled employees but this theory was impugned by numerous independent sources [1].

The toxic plume had barely cleared when, on December 7, the first multi-billion dollar lawsuit was filed by an American attorney in a U.S. court. This was the beginning of years of legal machinations in which the ethical implications of the tragedy and its affect on Bhopal's people were largely ignored. In March 1985, the Indian government enacted the Bhopal Gas Leak Disaster Act as a way of ensuring that claims arising from the accident would be dealt with speedily and equitably. The Act made the government the sole representative of the victims in legal proceedings both within and outside India. Eventually all cases were taken out of the U.S. legal system under the ruling of the presiding American judge and placed entirely under Indian jurisdiction much to the detriment of the injured parties.

In a settlement mediated by the Indian Supreme Court, UCC accepted moral responsibility and agreed to pay $470 million to the Indian government to be distributed to claimants as a full and final settlement. The figure was partly based on the disputed claim that only 3000 people died and 102,000 suffered permanent disabilities [9]. Upon announcing this settlement, shares of UCC rose $2 per share or 7% in value [1]. Had compensation in Bhopal been paid at the same rate that asbestosis victims where being awarded in US courts by defendant including UCC – which mined asbestos from 1963 to 1985 – the liability would have been greater than the $10 billion the company was worth and insured for in 1984 [10]. By the end of October 2003, according to the Bhopal Gas Tragedy Relief and Rehabilitation Department, compensation had been awarded to 554,895 people for injuries received and 15,310 survivors of those killed. The average amount to families of the dead was $2,200 [9].

At every turn, UCC has attempted to manipulate, obfuscate and withhold scientific data to the detriment of victims. Even to this date, the company has not stated exactly what was in the toxic cloud that enveloped the city on that December night [8]. When MIC is exposed to

200° heat, it forms degraded MIC that contains the more deadly hydrogen cyanide (HCN). There was clear evidence that the storage tank temperature did reach this level in the disaster. The cherry-red color of blood and viscera of some victims were characteristic of acute cyanide poisoning [11]. Moreover, many responded well to administration of sodium thiosulfate, an effective therapy for cyanide poisoning but not MIC exposure [11]. UCC initially recommended use of sodium thiosulfate but withdrew the statement later prompting suggestions that it attempted to cover up evidence of HCN in the gas leak. The presence of HCN was vigorously denied by UCC and was a point of conjecture among researchers [8,11-13].

As further insult, UCC discontinued operation at its Bhopal plant following the disaster but failed to clean up the industrial site completely. The plant continues to leak several toxic chemicals and heavy metals that have found their way into local aquifers. Dangerously contaminated water has now been added to the legacy left by the company for the people of Bhopal [1,14].

Go to:

Lessons learned

The events in Bhopal revealed that expanding industrialization in developing countries without concurrent evolution in safety regulations could have catastrophic consequences [4]. The disaster demonstrated that seemingly local problems of industrial hazards and toxic contamination are often tied to global market dynamics. UCC's Sevin production plant was built in Madhya Pradesh not to avoid environmental regulations in the U.S. but to exploit the large and growing Indian pesticide market. However the manner in which the project was executed suggests the existence of a double standard for multinational corporations operating in developing countries [1]. Enforceable uniform international operating regulations for hazardous industries would have provided a mechanism for significantly improved in safety in Bhopal. Even without enforcement, international standards could provide norms for measuring performance of individual companies engaged in hazardous activities such as the manufacture of pesticides and other toxic chemicals in India [15]. National governments and international agencies should focus on widely applicable techniques for corporate responsibility and accident prevention as much in the developing world context as in advanced industrial nations [16]. Specifically, prevention should include risk reduction in plant location and design and safety legislation [17].

Local governments clearly cannot allow industrial facilities to be situated within urban areas, regardless of the evolution of land use over time. Industry and government need to bring proper financial support to local communities so they can provide medical and other necessary services to reduce morbidity, mortality and material loss in the case of industrial accidents.

Public health infrastructure was very weak in Bhopal in 1984. Tap water was available for only a few hours a day and was of very poor quality. With no functioning sewage system, untreated human waste was dumped into two nearby lakes, one a source of drinking water. The city had four major hospitals but there was a shortage of physicians and hospital beds. There was also no mass casualty emergency response system in place in the city [3]. Existing public health infrastructure needs to be taken into account when hazardous industries choose sites for manufacturing plants. Future management of industrial development requires that appropriate resources be devoted to advance planning before any disaster

occurs [18]. Communities that do not possess infrastructure and technical expertise to respond adequately to such industrial accidents should not be chosen as sites for hazardous industry.

Go to:

Since 1984

Following the events of December 3 1984 environmental awareness and activism in India increased significantly. The Environment Protection Act was passed in 1986, creating the Ministry of Environment and Forests (MoEF) and strengthening India's commitment to the environment. Under the new act, the MoEF was given overall responsibility for administering and enforcing environmental laws and policies. It established the importance of integrating environmental strategies into all industrial development plans for the country. However, despite greater government commitment to protect public health, forests, and wildlife, policies geared to developing the country's economy have taken precedence in the last 20 years [19].

India has undergone tremendous economic growth in the two decades since the Bhopal disaster. Gross domestic product (GDP) per capita has increased from $1,000 in 1984 to $2,900 in 2004 and it continues to grow at a rate of over 8% per year [20]. Rapid industrial development has contributed greatly to economic growth but there has been significant cost in environmental degradation and increased public health risks. Since abatement efforts consume a large portion of India's GDP, MoEF faces an uphill battle as it tries to fulfill its mandate of reducing industrial pollution [19]. Heavy reliance on coal-fired power plants and poor enforcement of vehicle emission laws have result from economic concerns taking precedence over environmental protection [19].

With the industrial growth since 1984, there has been an increase in small scale industries (SSIs) that are clustered about major urban areas in India. There are generally less stringent rules for the treatment of waste produced by SSIs due to less waste generation within each individual industry. This has allowed SSIs to dispose of untreated wastewater into drainage systems that flow directly into rivers. New Delhi's Yamuna River is illustrative. Dangerously high levels of heavy metals such as lead, cobalt, cadmium, chrome, nickel and zinc have been detected in this river which is a major supply of potable water to India's capital thus posing a potential health risk to the people living there and areas downstream [21].

Land pollution due to uncontrolled disposal of industrial solid and hazardous waste is also a problem throughout India. With rapid industrialization, the generation of industrial solid and hazardous waste has increased appreciably and the environmental impact is significant [22].

India relaxed its controls on foreign investment in order to accede to WTO rules and thereby attract an increasing flow of capital. In the process, a number of environmental regulations are being rolled back as growing foreign investments continue to roll in. The Indian experience is comparable to that of a number of developing countries that are experiencing the environmental impacts of structural adjustment. Exploitation and export of natural resources has accelerated on the subcontinent. Prohibitions against locating industrial facilities in ecologically sensitive zones have been eliminated while conservation zones are being stripped of their status so that pesticide, cement and bauxite mines can be built [23]. Heavy reliance on coal-fired power plants and poor enforcement of vehicle emission laws

are other consequences of economic concerns taking precedence over environmental protection [19].

In March 2001, residents of Kodaikanal in southern India caught the Anglo-Dutch company, Unilever, red-handed when they discovered a dumpsite with toxic mercury laced waste from a thermometer factory run by the company's Indian subsidiary, Hindustan Lever. The 7.4 ton stockpile of mercury-laden glass was found in torn stacks spilling onto the ground in a scrap metal yard located near a school. In the fall of 2001, steel from the ruins of the World Trade Center was exported to India apparently without first being tested for contamination from asbestos and heavy metals present in the twin tower debris. Other examples of poor environmental stewardship and economic considerations taking precedence over public health concerns abound [24].

The Bhopal disaster could have changed the nature of the chemical industry and caused a reexamination of the necessity to produce such potentially harmful products in the first place. However the lessons of acute and chronic effects of exposure to pesticides and their precursors in Bhopal has not changed agricultural practice patterns. An estimated 3 million people per year suffer the consequences of pesticide poisoning with most exposure occurring in the agricultural developing world. It is reported to be the cause of at least 22,000 deaths in India each year. In the state of Kerala, significant mortality and morbidity have been reported following exposure to Endosulfan, a toxic pesticide whose use continued for 15 years after the events of Bhopal [25].

Aggressive marketing of asbestos continues in developing countries as a result of restrictions being placed on its use in developed nations due to the well-established link between asbestos products and respiratory diseases. India has become a major consumer, using around 100,000 tons of asbestos per year, 80% of which is imported with Canada being the largest overseas supplier. Mining, production and use of asbestos in India is very loosely regulated despite the health hazards. Reports have shown morbidity and mortality from asbestos related disease will continue in India without enforcement of a ban or significantly tighter controls [26,27].

UCC has shrunk to one sixth of its size since the Bhopal disaster in an effort to restructure and divest itself. By doing so, the company avoided a hostile takeover, placed a significant portion of UCC's assets out of legal reach of the victims and gave its shareholder and top executives bountiful profits [1]. The company still operates under the ownership of Dow Chemicals and still states on its website that the Bhopal disaster was "cause by deliberate sabotage". [28].

Some positive changes were seen following the Bhopal disaster. The British chemical company, ICI, whose Indian subsidiary manufactured pesticides, increased attention to health, safety and environmental issues following the events of December 1984. The subsidiary now spends 30–40% of their capital expenditures on environmental-related projects. However, they still do not adhere to standards as strict as their parent company in the UK. [24].

The US chemical giant DuPont learned its lesson of Bhopal in a different way. The company attempted for a decade to export a nylon plant from Richmond, VA to Goa, India. In its early negotiations with the Indian government, DuPont had sought and won a remarkable clause in its investment agreement that absolved it from all liabilities in case of an accident. But the people of Goa were not willing to acquiesce while an important ecological site was

cleared for a heavy polluting industry. After nearly a decade of protesting by Goa's residents, DuPont was forced to scuttle plans there. Chennai was the next proposed site for the plastics plant. The state government there made significantly greater demand on DuPont for concessions on public health and environmental protection. Eventually, these plans were also aborted due to what the company called "financial concerns". [29].

Go to:

Conclusion

The tragedy of Bhopal continues to be a warning sign at once ignored and heeded. Bhopal and its aftermath were a warning that the path to industrialization, for developing countries in general and India in particular, is fraught with human, environmental and economic perils. Some moves by the Indian government, including the formation of the MoEF, have served to offer some protection of the public's health from the harmful practices of local and multinational heavy industry and grassroots organizations that have also played a part in opposing rampant development. The Indian economy is growing at a tremendous rate but at significant cost in environmental health and public safety as large and small companies throughout the subcontinent continue to pollute. Far more remains to be done for public health in the context of industrialization to show that the lessons of the countless thousands dead in Bhopal have truly been


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Bhopal Gas Tragedy Victims Still Fighting For Justi

By BGPMUS & BGPSSS

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STATEMENT ON THE OCCASION OF THE 29 TH A
DISASTER

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The escape of about 40 tonnes of methyl isocyanate (MIC) -
pesticide plant of Union Carbide India Limited (UCIL) in Bl
resulted in a terrible disaster. Due to criminal negligence an
management in taking adequate safety precautions, water a
violently – entered one of the MIC storage tanks resulting in
reaction products to escape in the form of froth and lethal g

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heavier than air, spread across 40 sq. kms of area of Bhopal leaving in its wake more than 20,000 dead (over several yea about 550,000 other human inhabitants. The pernicious im equally grave. UCIL was then under the control of Union Ca company, which is currently wholly owned by the Dow Che

As noted on previous occasions, even nearly three decades a Government has made any attempt to either undertake a co the Bhopal disaster or to take necessary remedial measures. concerted struggles in their quest for medical relief, compen partial success on the litigation front, lack of progress on m gas-victims continue to remain a source of major concern. T enhancement of compensation, prosecution of the accused, briefly recounted as follows:

1. HEALTH : The gross indifference on the part of the Stat the gas-victims continues to be as grim as ever. Apart from built in terms of buildings and number of hospital beds beca organizations supporting the cause of the Bhopal gas victim investigation, diagnosis and treatment continue to be abysm Council of Medical Research (ICMR) and the State of Madh Bhopal gas victims – through computerization and network the supply of health-booklet to each gas-victim with his/her least. That a proper protocol for treatment of each gas-relat after the disaster speaks volumes about the apathetic attitud

It was because of this utter insensitivity on the part of the IC Bhopal Group for Information & Action (BGIA) and BGPSS

Petition (No.50 of 1998) before the Supreme Court on 14.01 disaster-related medical research, monitoring and recordin improvement in health care facilities, appropriate protocol After 14 years of litigation, the Supreme Court acceded to th dated 09.08.2012 had issued necessary directions to the IC Petitioners were further directed to pursue the matter befor the Petitioners are actively engaged in at present. However, Supreme Court passed the said Order dated 09.08.2012, ne taken the necessary steps to comply fully with all the directi

At the behest of BGPMUS and BGPSSS, the Supreme Court National Informatics Centre (NIC), which is under the Unio Technology and which has been entrusted with the task of c victims, to be impleaded as a Respondent in the case. More Court has directed the NIC to interact with the Monitoring computerization of medical records and issuance of health b medical record. (The Monitoring Committee, which include the State Government, was set up by the Supreme Court vid status of the gas-victims.) The High Court will issue further

The urgency of restarting medical research arising from and had abandoned in 1994, can in no way be underplayed espe high morbidity rate in the gas-exposed areas of Bhopal. The disaster that the ICMR has published so far provide ample among the progenies of some of the gas-victims are also a m

2. COMPENSATION : Twenty-one years after the unjust Union of India had decided to file a curative petition [Curat

the Supreme Court on 03.12.2010 against the terms of the S
based on underestimated figures of the dead and injured. Th
taken up for hearing. BGPMUS and BGPSSS do support the
total casualty figure (i.e., 5,73,000, including dead and injur
compensation (i.e., that it should be based on the Dollar-Ru
Settlement). However, BGPMUS and BGPSSS have serious
number of dead (just 5295) and the seriously injured (just 4
rehabilitation and for environmental damage. The stand of
dead (20,000+) and seriously injured (150,000+) has alrea
(SLP) that is currently pending before the Supreme Court as
only after the disposal of UOI's Curative Petition. On 24.10.
Interlocutory Application in UOI's Curative Petition (C) Nos
the same and praying for granting appropriate relief. It is as
attempt to place the relevant ICMR reports before the Claim
the types and gravity of injuries suffered by the Bhopal gas v
which the ICMR and the State Government had failed to pro
would have been very valuable in determining the likely deg
BGPSSS hope that the said Curative Petition, which has bee
three years, would be disposed of without further delay.

3. CRIMINAL CASE : The criminal cases against the accu
against the three absconding accused and the other against
Judicial Magistrate (CJM), Bhopal, to face trial. Through Ju
has prosecuted the said eight accused persons under Section
State of MP and BGPMUS & BGPSSS had filed Criminal Rev
the Sessions Court, Bhopal. By completely overlooking the p
contentions of the accused in toto, the Sessions Court, Bhop

Revision Petition No.632 of 2010 against the said Judgmen
barred by limitation". The CBI had sought enhancement of
accused from Section 304-A to Section 304 Part-II of IPC o
the CJM. Thus, the ray of hope that was visible in the Supre
Petition (Cr.) Nos.39-42 of 2010, which was that the misrea
Appeals Nos.1672-1675 of 1996 by the CJM *"can certainly b*
court", has suffered a serious setback. Moreover, the ferven
that the State of MP as well as BGPMUS & BGPSSS had file
would receive favourable consideration were also thwarted
said Revision Petitions after keeping the same pending und
already expressed their utmost displeasure at the extremely
proceeding and their demand for setting up a special court
acceded to by the State Government.

As of now, BGPMUS and BGPSSS, which were instrumenta
in 1991 by filing an appeal and a writ petition against the un
no locus in proceeding with the criminal cases against the I
the circumstances, accused Nos.2 to 9 can rest content that
their lifetime for the heinous crime they had committed is n
imprisonment at the time of arrest is the only privation that
No.4 has not faced even that inconvenience to date! Needles
rendered justice in their lifetime for the loss & suffering the
remains as remote as ever.

The criminal case against the three absconding accused, na
pending before the Court of the CJM as Miscellaneous Judi
proceeding at an equally tardy pace. After acceding to the pl

07.09.2001, the CJM had issued notice to the Dow Chemica in the criminal case on behalf of the absconding accused No which had become a wholly owned subsidiary of DOW in 20 at Jabalpur had stayed the said order of the CJM at the urgi stay was vacated only seven years later on 19.10.2012, when CJM's Order dated 06.01.2005. After BGPSSS & BGPMUS l attention of the CJM, Bhopal, through an Application dated posted for hearing on 07.01.2013. However, it is highly regr re-issued the notice to DOW even nearly a year later. BGPSS the CJM that proceeding against the absconding accused No after the Chief Metropolitan Magistrate, Delhi, had issued a CBI for the purpose. The fact is, the Union of India has mad the matter is reportedly pending before the U.S. Administra which the trial against the accused in the Bhopal disaster cr years makes a mockery of the criminal justice system in the placing these facts before the higher courts for appropriate

4. ENVIRONMENTAL REMEDIATION : Toxic waste t 1969 to 1984 was dumped in and around the plant leading t comprehensive study to estimate the extent and gravity of th or the State Government to date. Instead, the magnitude of making it appear that the total toxic waste that needs to be s stored at the plant site. The matter is before the Supreme Co current proposal to incinerate/bury the toxic waste near Ind result in shifting the problem from Bhopal to Indore. On the carried out by the National Environmental Engineering Res National Geophysical Research Institute (NGRI), Hyderaba

total quantum of contaminated soil requiring remediation tonnes] " (p.68). Based on the "Polluter Pays Principle", it is Company, USA, which currently owns UCC, to meet the cos environment in and around the UCIL plant with the latest a cost of providing safe-drinking water to the affected popula too has to be borne by DOW. However, the responsibility fo population is entirely that of the State Government.

At the initiative of the Centre for Science and Environment April 2013 to bring together on a common platform the vari Plan to remediate the degraded environment. While a draft further refinement as well as inputs from other experts and Madhya Pradesh.

5. RELIEF & REHABILITATION : The State Governme sensitivity a whole host of socio-economic problems that co differently abled, the widowed, and other vulnerable sectio disbursed as compensation in most instances to these secti needs. Finding gainful employment in accordance with the life has been a serious challenge. The State Government has issue than in the past.

On the 29 th anniversary of this man-made-disaster, the Bh (BGPMUS) and the Bhopal Gas Peedith Sangharsh Sahayog deceased victims and reiterate their determination to contin seek justice for the hapless victims.

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