

Harsh lessons in OHS history: the Union Carbide disaster

The 1984 Union Carbide disaster in Bhopal, India, is perhaps the world's starkest lesson in how occupational health issues can transform into an enduring public health catastrophe, write Tim Edwards and Colin Toogood



A father's raw grief on the morning of 3 December 1984, after pleas for doctors to "save my son" came too late at Hamidia hospital, Bhopal. Photo Credit: Kamlesh Jamini (Jamini Photo Studio Bhopal)

“I know that I am not doing the right thing,” the engineer confessed. “However, this is the practice and my superiors are fully aware of what I am doing.” A pause.

“Therefore, I am not doing anything wrong.” His final words betray desperation. “God is with me.”

The 40-page report by the Union Carbide pesticides factory's in-house safety team involved dozens of interviews. It emphasised glaring safety issues in standard operations, facilities and procedures right across the plant's most hazardous production units. Due to particular deficiencies, the report warned, “There may be cases involving runaway reaction”. In such a scenario, “There is no procedure available for handling a vapour cloud release”. Managers stung by the strongly worded report asked the authors to “soften and dilute” their observations.

Less than three months later, a runaway reaction duly vaporised 28 tonnes of deadly methyl isocyanate (MIC), a highly “reactive, toxic, volatile and flammable” chemical and an acute “oral and contact poison” that was bulk-stored onsite in tanks the size of locomotives.

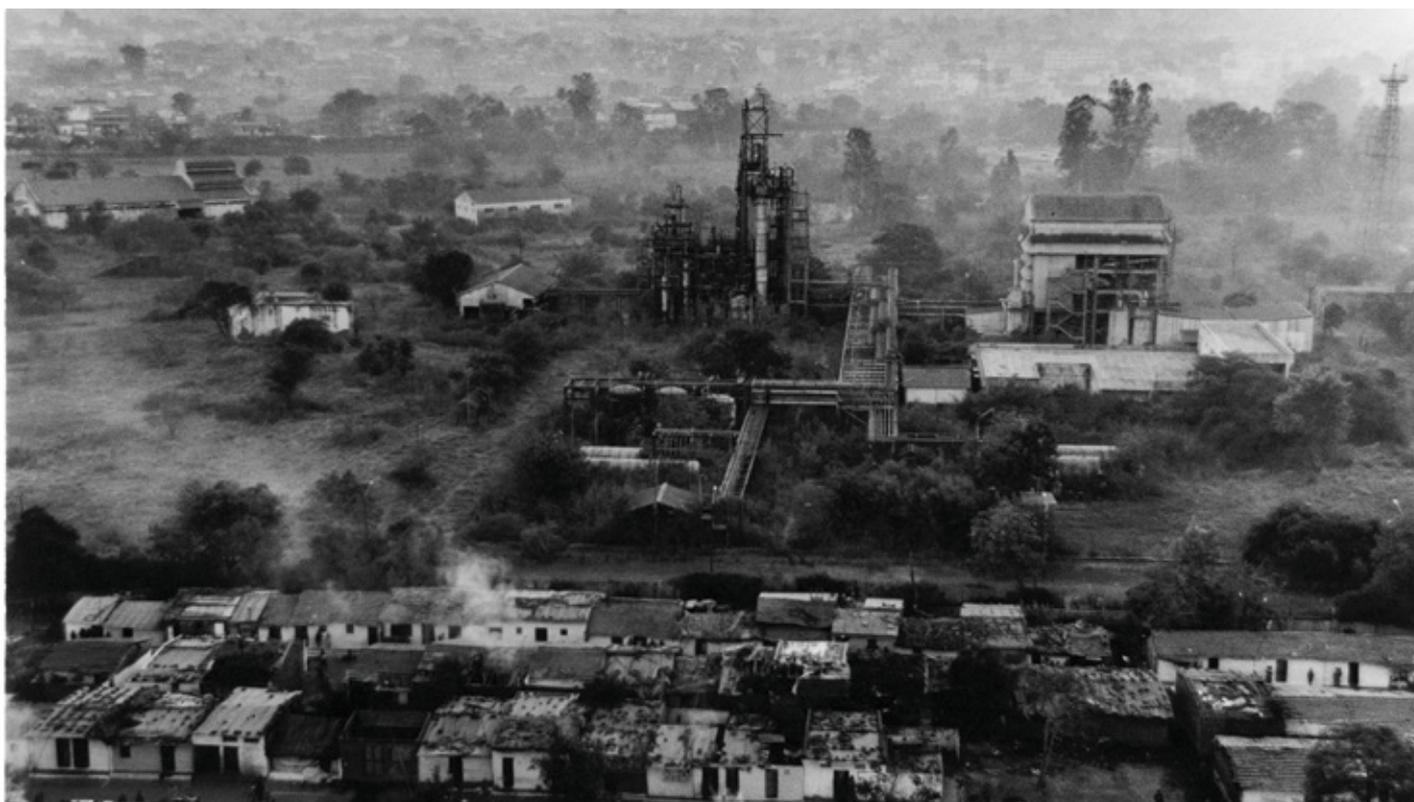
Avoidable failures were legion. Unreliable or disabled instruments contributed to workers only spotting the rapid increase of heat and pressure when the reaction was already out of control. Six safety systems meant to safeguard the use of MIC were either out of commission or not up to the job of neutralising the escaping vapours. No warning sounded as the gases blasted through the chief safety device at some 200 times the pressure it had been designed to handle.



The gleaming tower and pipework of Union Carbide's MIC unit in Bhopal, shortly before it began manufacturing the deadly chemical in 1980. The white tower in the foreground is the “vent gas scrubber”, the unit's chief safety device which proved to be entirely unfit to meet the heat, pressure and quantity of gases that blasted through it on the night of 2 December 1984. Photo Credit: Kamlesh Jamini (Jamini Photo Studio Bhopal)

A vast poison cloud formed above the plant's tangle of pipework. Caught by a cold northerly breeze, it drifted down and rolled towards Bhopal's central train station, swiftly and silently blanketing 16 square miles of the sleeping city. By the time locals awoke to the danger, the gas was already upon them, dense, burning, suffocating.

What followed is commonly known as the worst industrial catastrophe in history. The figures defy ordinary comprehension: best estimates say that within the first 72 hours, between 8000 and 10,000 men, women and children perished, many in the most atrocious ways. Over the first weeks, 160,000 were admitted to local hospitals, but this was



An aerial view of the Union Carbide pesticides factory and surrounding communities in 2002. Growing urbanisation and the gradual spread of contaminants within aquifers has led to 42 separate communities being exposed to groundwater contamination since the 1984 disaster, a number of them already gas-affected. Photo credit: Raghu Rai / Magnum

only the beginning. Officially recognised victims of Union Carbide's disaster in Bhopal now total almost 600,000, whereas unofficial estimates place the death toll today at 25,000, or possibly more.

Disaster by design

Union Carbide used MIC as an intermediate in the manufacture of carbamate pesticides like Sevin, which in the late 1960s found a growing market in "Green Revolution" India. By 1972, US engineers began designing major "high technology" units for manufacture in Bhopal, based upon Carbide's only other existing facility in Institute, West Virginia. In signed technology transfer agreements, "the best manufacturing information presently available from or to Union Carbide" was promised Union Carbide India Ltd (UCIL), a local subsidiary incorporated by the American parent in 1934.

Carbide nevertheless deviated from these agreements within three weeks. "Unproven technology" was designated for the MIC-Sevin process in an effort to cut 25 per cent from the cost of the US\$28 million investment. The reason? Under the terms of India's new *Foreign Equity Regulation Act* (FERA), overseas investments were subject to strict controls. Larger investment in Bhopal threatened to dilute Carbide's majority shareholding in UCIL. A loss of majority equity would lead to a loss of management control, and hence a loss of royalties, technical and service fees.

Early ambitions for Bhopal were soon tempered by other economic realities. Described as "an oversized plant for an undersized market", the company considered abandoning the project

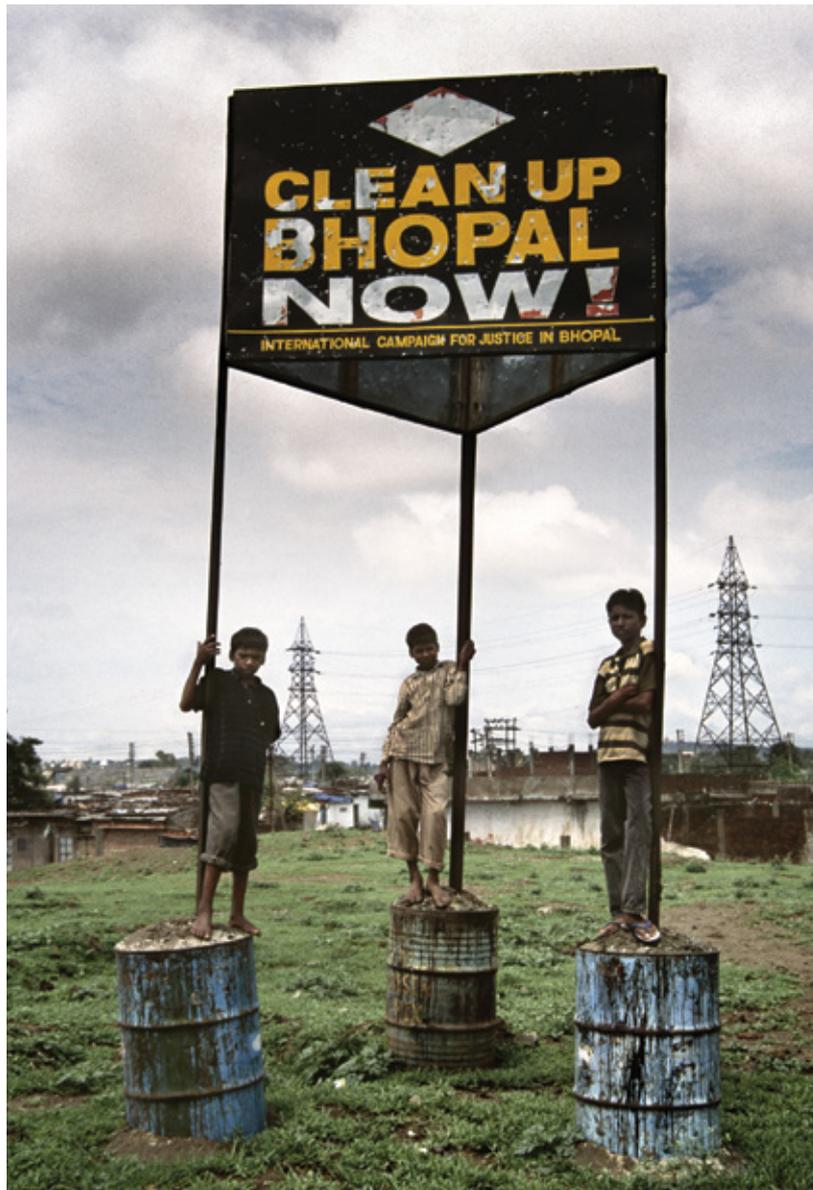
altogether, even before the build-stage was complete. But the plant was critical to Carbide's plan to gain special exemption from FERA and in this way hold onto a majority of UCIL. The project therefore continued, but planned investments were again slashed. This time, construction materials were among the compromises: in one instance, local carbon steel parts replaced "expensive American-standard" steel.

Due to its corrosiveness, carbon steel is incompatible with MIC. Stainless steel is an inherently safer choice which mitigates the rusting hazard. In an earlier "Corrosion Review", engineers at Institute, West Virginia, reported that over 448 days of operations almost every item in the MIC unit had failed and been replaced. They insisted that if another facility was built to manufacture MIC, "materials of construction at least as good as those presently used... will be required". For Carbide, however, equity seems to have trumped safety.

Non-standard procedures

Kenneth Bloch, a PHA/loss control engineer, detailed some of the major process safety failures in Bhopal in *Hydrocarbon Processing* (2012). A series of chronic MIC leaks from as early as 1982 (see sidebox) led to the introduction of alternative safety procedures. Bloch points out that "non-standard operating procedures may address one hazard while introducing others". In Bhopal they interrupted the flow of nitrogen into system parts made from carbon steel, letting in air and thereby allowing pipes to corrode. Maintenance procedures had to be devised to flush out MIC trimer deposits

"By the time locals awoke to the danger, the gas was already upon them, dense, burning, suffocating"



A protest banner erected within contaminated communities in Bhopal and directed at Dow Chemical, since 2001 the sole owner of Union Carbide. Photo credit: Maude Dorr



with water – routine water-washing is considered the likeliest source of the iron and water that were catalysing agents in the eventual disaster.

Had MIC been kept at 0°C for safe storage, as required by manuals, there may have been time to prevent catalysts causing a thermal runaway reaction. However, a number of seal failures connected to circulation pumps led to a decision to shut down the MIC refrigeration system. MIC was henceforth stored between 15°C and 40°C, thus, high temperature alarms were also disconnected. If the tank temperature soared, there would now be no warning.

Skilled operators are also key to hazard management. But in 1983 a major “operations improvement program”, driven by losses and equity priorities, saved the company a cool US\$1.25 million by, among other things, making 333 workers redundant. As a result, UCIL managers made Bhopal unions sign a memorandum of agreement “eliminating such work practices which are not conducive to efficient working of the plant”. Numbers of field maintenance staff and operators in the MIC unit were halved. Operator training was slashed from six months to two weeks. Managers in Hong Kong observed that “future savings of such magnitude would not be easy”. There was little left to cut.



A poster detailing a list of toxic chemicals found in harmful quantities in local drinking wells, exhibited at Chingari Trust, a local centre rehabilitating children damaged by gas and water poisoning in Bhopal. Photo credit: Giles Clark / Getty Images

Disaster without end

Over time, communities usually find ways to recover from natural disasters. A technological disaster endures. Bhopal has a beginning, but no end. It is happening still, and it is happening now, even as you read these words.

MIC didn't only attack the lungs. Crossing the pulmonary barrier, it hitched onto amino acids, was ferried through the blood, then broke down, causing damage to organs, to immune, nervous and reproductive systems, to cells and to genes. Community researchers recently confirmed worst fears. Those exposed to gas are developing cancers – chiefly of the kidneys, throat and lungs – at 10 times the rate of locals who were unexposed.

It doesn't stop at this. Damaged children are being born in Bhopal in such numbers that there is really no foreseeable end to Carbide's disaster.



A view of the Sevin and MIC units in Bhopal in 2010. Pools of mercury found under the Sevin unit have found their way into local water supplies. Seasonal brush fires have sometimes come close to igniting tiger grass around derelict facilities, leading to fears of new releases of MIC vapours. Photo credit: Ryan Lockhart

“Less advanced environmental consciousness”

Even if the 1984 disaster had been averted, Bhopal would have suffered a chemical tragedy. During normal operations, huge quantities of toxic waste were routinely dumped in and around the site, with thousands of tonnes buried in unlined pits.

Sodium chloride wastes were also pumped into huge lakes a few hundred metres north. Engineers from Union Carbide’s Technical Centre in West Virginia designed the three enormous “solar evaporation ponds” but also warned that the design risked the “danger of polluting subsurface water supplies in the Bhopal area...”, concluding that “The essence of (the) proposed solution, lies in the less advanced environmental conscienceness (sic) in India.”

By 1989, Carbide began testing soil and water samples from the factory site and found every sample lethal to fish. Toxic chemicals had leached from the abandoned waste into the groundwater aquifer of nearby slums, which residents were using as their primary supply. Carbide kept the test findings to itself, issuing no warning to locals.

Chemicals found in Bhopal community wells are known to damage the brain, liver and nervous system and cause cancers and birth defects. Although a full contamination survey has never been carried out, various studies reveal that toxic chemicals have spread for several miles through the underground aquifer, affecting tens of thousands of people. In 2006, a team of doctors held a camp in these areas. One said they had never seen so many cases of cerebral palsy in a single population. Residents of 42 housing colonies are now potentially exposed to contaminated water. In 1984, a number of those colonies were among the first to be gassed.

Multiple warnings before the disaster

Between 1978 and 1984 the Department of Industry Safety and Health recorded six major accidents at the plant – a figure which workers at the plant dispute as under-counted. As a direct result, one worker died and at least 47 were injured, many seriously.

In December 1981, one engineer died after a leak exposed him to liquid phosgene.

In January 1982, a ceramic pump seal shattered, releasing phosgene and hospitalising 24 workers.

In February 1982, an MIC leak injured 18. Unions lobbied visiting overseas executives about the dangerous conditions due to failing equipment.

In May 1982, parent Union Carbide conducted an “Operational Safety Survey” that noted numerous lapses in safety regulations, highlighting 10 hazards classified as “major” in the fatal MIC unit alone. The auditors

also praised the factory’s “creative approach” to improving workplace safety with non-standard operating and maintenance procedures.

On 5 October 1982, hundreds of residents of adjacent slums fled their homes when a loose-fitting valve released a cloud of MIC, chloroform and hydrochloric acid, seriously injuring four workers.

Shortly after, workers’ unions led a community awareness campaign with thousands of warning posters. “Lives of thousands of workers and citizens in danger because of poisonous gas”; “Safety measures deficient”.

The incidents prompted a series of articles by a local journalist warning of a major disaster, leading to questions in the state parliament but no action. Local factory inspectors, dependent on Union Carbide’s technical know-how and reassurances, renewed the plant’s manufacturing licence 15 times.

Standing with the survivors

In 1989, India settled with Carbide out-of-court for 15 per cent of its original claims. For the deaths of thousands and the maiming of half a million more, Carbide’s punishment amounted to a \$0.49 cent per share hit on pre-tax dividends for the 1989 financial year. It granted \$2000 for each death, \$500 to each incurably ill victim.

Today there are thousands of families all over Bhopal who are desperately ill, penniless, without social support, without effective medical treatment, without emotional or psychological closure, caught up in an endless cycle of re-victimisation.

Unable to stand by and watch innocent people suffer and die without help, ordinary people around the world have joined together to fund two award-winning clinics in Bhopal. Both were founded by survivors themselves and are the only places where 10,000 families poisoned by water-borne toxins can go for free first-class care.

The Sambhavna Trust has eased the suffering of over 32,000 people by combining conventional and Ayurvedic medicine with community health work. The Chingari Trust offers hundreds of children physiotherapy and speech therapy, skills training and basic education. There is no one else to do this work. ■

Tim Edwards is executive trustee and Colin Toogood is campaigns manager for British charity The Bhopal Medical Appeal. Edwards has advocated on behalf of Bhopal for twenty years, advising on the social, legal, environmental and medical complexities of Union Carbide’s disaster. For more information visit www.bhopal.org.