The Bhopal Saga
Causes and Consequences of the World’s Largest Industrial Disaster

Sevesokonferensen
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The Bhopal Disaster 1984

• Release of 43 tonnes of methyl isocyanate (MIC)
• The world’s largest industrial disaster?
• The symbol of negligence from transnational corporations
• Led to a series of conventions and laws all over the world
Bhopal, in the middle of India, is the capital of Madhya Pradesh, and a railway junction.

In 1984, it had 700,000 inhabitants. Today, there are about 1.2 millions.
Injury analysis

• The Haddon matrix: Pre-event, event and post-event phases.
• Logical Framework Approach: Problem tree and tree of objectives.
THE PRE-EVENT PHASE
1950s – 1984 November

The process that led to the leakage
India in the 1950:s

- Failure of the crops
- Attacks by insects
- Famines
The Green Revolution

• Irrigation
• Fertilizers
• Pesticides

1969 UCIL

• 51% was owned by UCC
• 49% was owned by Indian authorities
• Sevin (carbaryl)
Science helps build a new India

Oxen working the fields . . . the eternal river Ganges . . . jeweled elephants on parade. Today these symbols of ancient India exist side by side with a new sight—modern industry. India has developed bold new plans to build its economy and bring the promise of a bright future to its more than 400,000,000 people. But India needs the technical knowledge of the western world. For example, working with Indian engineers and technicians, Union Carbide recently made available its vast scientific resources to help build a major chemical and plastics plant near Bombay. Throughout the free world, Union Carbide has been actively engaged in building plants for the manufacture of chemicals, plastics, carbons, gases, and metals. The people of Union Carbide welcome the opportunity to use their knowledge and skills in partnership with the citizens of so many great countries.

A HAND IN THINGS TO COME

WRITE for booklet 8-3: "The Existing Universe of Union Carbide," which tells how research in the fields of carbons, chemicals, gases, metals, plastics and nuclear-energy helps bring new wonders into your life.

Union Carbide Corporation, 230 Park Avenue, New York 17, N. Y.
Methyl isocyanate (MIC) is used as an intermediate in the production of carbaryl.
"The beautiful plant"

The MIC-unit that was added in 1979
Design of the MIC-unit

1. MIC was used instead of less toxic but more expensive materials

2. Storing of large amounts of MIC in few large tanks instead of several small tanks

3. Safety systems inadequate.

4. Location close to a densely populated area

5. The alarm system not addressing the inhabitants
Management

1. Safety rules not followed

2. Maintenance of plant bad

3. Staff reduced, uneducated
The situation Dec 2

Tank 610 contained 43 tonnes MIC, much more than allowed according to safety rules
Most of the safety systems were out of order at the night of Dec 3, 1984.
THE EVENT PHASE
December 1984
December 2-3

• Large amounts of water entered tank 610

• A chemical reaction started, releasing 43 tonnes of toxic gases that spread over the sleeping town
Direct cause

1. Water washing theory
2. Direct entry theory (sabotage)
The cloud contained a mixture of substances. Concentrations were higher close to the plant. The gases were heavier than air, displacing oxygen.
Inside plant area

• 09.00 PM  Water washing starts.
• 10.30 PM  Increased pressure of tank 610 noted.
• 11.00 PM  MIC in process area noted.
• 00.15 AM  Tank rumbling, concrete casing split. Increasing MIC in air.
• 00.50 AM  Alarm inside factory.
• 01.30 AM  Workers left plant area.
• 02.00 AM  The loud outside alarm was started.
• 02.15 AM  Gas leak stopped.
Outside plant

11.30 PM  First sensations. Suffocation, cough, eyes, vomiting.
2.00 AM   The first reached Hamidia hospital. Half blind, gasping for air, frothing at the mouth, vomiting.
2.10 AM   The alarm was heard.
4.00 AM   The gases reduced.
6.00 AM   The police's loudspeaker: everything is normal.
But it was not normal ...
Next day

• Thousands of dead bodies on the streets. Everyone on the railway station died.

• The corpses were collected and dumped into Narmada river, mass funerals, mass cremations.

• 2 000 buffaloes, goats etc. dead.
Coming days

- The health care staff became exposed to the gases.
- Stop at 550 registered dead.
- UC’s doctor: "It is like tear gas."
- 170,000 were treated at hospitals and temporary dispensaries.
- 700 doctors, 250 nurses, 870 others.
Within the next few days

- The leaves went yellow, fell off.
- Business stopped. Food did not get into town. Fishing was forbidden.
- The town was invaded by health care staff and American lawyers.
- Contradictory information from the authorities.
Acute effects

- Irritation in air ways, cough, suffocating. Small airways constricted, lungs filled with water.
- Severe irritation of eyes, corneal ulcers.
- Spontaneous abortions, death of foetuses, increased infant death rate.
- Autopsy: oedema of brain, kidneys swollen, necrotic.
Treatment

• Symptomatic.
• Contradictory recommendations from UCC and GoI on HCN antidote NaTs → not acute treatment.
Affected

• The poorest, who lived closest to the plant, were hit hardest.
• The shortest (the children) were hit hardest.
Magnitude of the disaster

Exposed:
• 520,000 (36 wards) – 730,000 (56 wards)
• > 200,000 were below 15 years of age
• > 3,000 were pregnant women

Dead:
• > 8,000 (→ 16,000?) during first weeks
• > 3,000 below 15 years
• 8,000 (?) died since (2004)

Permanent injuries:
• 100,000 – 200,000
NOT EVERYONE AFFECTED BY THE CARBIDE GAS LEAK IN BHOPAL DIED.
Exposure had been less if the inhabitants

- had been warned earlier by the alarm
- covered their faces with a wet cloth
- stayed indoors if they lived in good houses
- walked in stead of run
- had moved in right angle to the wind instead of in the same direction

But they did not know …
THE POST-EVENT PHASE
1985 →
Data collectors

- The TATA-institute
- Indian Council of Medical Research (ICMR)
- Centre for Rehabilitation Studies (CRS)
- India Toxicology Research Centre (ITRC)
- Defense Research Development Organ (DRDO)
- Indian Council of Agricultural Research (ICAR)
- National Environment Engine Research Institute (NEERI)
- Bhopal Cancer Register
- Council for Scientific and Industrial Research (CSIR)
- Hospitals and clinics
- Independent national and international institutions
ICMR: Long term effects

- Eyes
- Respiratory system
- Heart failure secondary to lung injuries
- Immune system
- Neurological system
- Psychological effects
- Women’s reproductive health
- Genetics
- General over morbidity
ICMR and others: Clinical studies

- Uncontrolled observations on small populations
- Do not conclude causality
Supplying of knowledge

• UCC has kept silent.
• Official research was kept secret.
• The research has many shortcomings.
• Neither GoI nor UCC have been interested in increasing and/or spreading knowledge.
Polluted groundwater

• Impression increased malformations
• No proper epidemiology
Conclusions

• The quality of the epidemiological and clinical research varies.
• The different reports support each other.
• The findings are also supported by animal experiments.
Late effects

Late cases that might never be highlighted:

- Post traumatic stress disorder (PTSD)
- Respiratory insufficiency
- Cardiac insufficiency
- Cancer
- Tuberculosis
- Children born after disaster
Injury analysis

• The Haddon matrix: pre-event, event and post-event phases.
• Logical Framework Approach: Problem tree and tree of objectives.
Washing pipelines, water entered tank 610

Many dead and injured, survivors poorer

Gov. of India and MP

Plant design

Economic pressure

UCC
Figure 8. Problem tree in LFA. Yellow = responsibility of UCC. Green = responsibility of the Governments of India and Madhya Pradesh.
Fig. 9. Tree of objectives. Yellow = responsibility of UCC. Green = responsibility of the Governments of India and Madhya Pradesh.

REDUCED RISK FOR LEAK

Safe plant design
Appropriate safety system
Few people around the plant
Location of plant
Sanction from authorities
Money

REDUCED RISK FOR INJURY

Automatic alarms
Appropriate maintenance
Operators react appropriate
Public alarm
Citizens educated
Police, fire brigade educated
Emergency plan

GOVERNMENTS OF INDIA & MP

Operators react appropriate
Public alarm
Citizens educated
Emergency plan

UCIL

UCIL

Sanction from authorities
Money

Education
Personnel management policy

Health care plans
Information on risks

Socio-economic standard good
Long term treatment good
Acute treatment good
Good houses

Good houses

Long term treatment good
Acute treatment good
Few people around the plant

Safe plant design
Appropriate safety system

GOVERNMENTS OF INDIA & MP
1. To create the mega-gas leak, it was not enough that water entered the tank.

2. The most important factors for the leak were the plant design and the economic pressure.

3. The most important factor for the outcome of the leakage is the negligence of the Union Carbide Corporation and the Governments of India and Madhya Pradesh.
Conclusions

• Irrespectively of the direct cause to the leakage, it is only two parties that are responsible for the magnitude of the disaster: Union Carbide Corporation and the Governments of India and Madhya Pradesh.
Today, the MIC-plant is falling apart. Is this a picture of chemical industries’ future?
गैस काण्ड की दसवीं बरसी
प्राच सबूत: सेकंड हिरोशिमा?
यूनियन कार्बाइड भारत घोड़ो.

शहज़ादी बहार
भोपाल गैस पीड़ित महिला
उद्योग संगठन

यूनियन कार्बाइड भारत घोड़ो.
Hazardous Industry is a Demon invading every part of the body and spewing poisons in to the Environment. Union Carbide is the Demon which spewed Death and Destruction over the city of Bhopal on Dec 2/3 1984.

ब्यौपाल गैस त्रासदी
Today, people have moved in to the area around the plant
In some areas, where the water is extremely polluted, the GoMP provides drinking water in tanks.
Today, the survivors are fighting their "own lawyer" to get their rights

"The Bhopal Gas Leak Disaster Act" March 1985
Compensation

- UCC offered USD 350 million = insurance sum
- GoI claimed USD 3.3 billions
- After lunch, Febr 14 1989: GoI accepted 470 million "in full an final settlement of its civil and criminal liability"
2001
Asbestos workers in USA

• Combustion Engineering, USA, had asbestos workers during the 70:s
• ABB, Sweden, took over the company 1991, including compensation claims for those ill
• 2003: ABB has to pay $1.1 billion to 438,000 claimants
Fighting 2015

• Clearings of the plant area
• The polluted ground water
• The handicapped children
• Ongoing court cases in US and India
Health care 2015

Sambhavna Trust
• Exposed to gases or polluted water
• Western and Ayurvedic medicine

Chingari Trust
• Handicapped children to the same groups