
Bhopal Gas Tragedy

(3-12-1984)

An investigation.....

Union Carbide Corporation

- **Nearly 100 years old company**
 - **Vast business opportunities**
 - **1st world war : Year 1914 to 1918**
 - ❖ **Helium gas for balloons / airships**
 - ❖ **Gas masks for USA, UK, France**
 - ❖ **Zirconium for cannon shielding**
 - **After world war, focus shifted to agriculture.**
 - **Business was diversified to fertilizers
(ammonia, urea etc.)**
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Union Carbide Corporation

- **By 1955, UCC had 130 subsidiaries and 500 manufacturing units in the world.**
 - **UCC decided to invent stronger pesticide than DDT due to its toxicity to human.**
 - **Two scientists Harry Hains and Hurbert Murfield were on this job.**
 - **3 years later, in 1957, their 77th formulation clicked.**
 - **Lucky number 77 was abbreviated as SEVIN**
 - **Experiments on rats gave very strong & excellent, but horrifying results. Company banned publication of results any where.**
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Union Carbide & India

- **During 1966, nearly 25 years after Independence, India was on path of Green revolution.**
 - **Hybrid crops had 3 times more yield, but poor resistance to insects / pests.**
 - **Govt. encouraged Industries to make Pesticides & gave concessions. Internationals were also invited.**
 - **UCC International Sales Executive Mr. Muonoze had great success in Mexico, Peru , Columbia, Argentina, Chilly & Brazil. He came to India & grabbed opportunity.**
 - **MOU was signed at Asoka Hotel in New Delhi for**
 - ❑ **Immediate shipment of 1200 tons as seeding programme.**
 - ❑ **Then setting up of manufacturing Unit.**
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Union Carbide & India

- **Parcel of 1200 tons of SEVIN was stuck up at Alexandria port of Egypt since SEVIN was not classified in the list of importable goods.**
 - **Mr. Muonoze grabbed the opportunity & brought consignment to India as fast seeding program.**
 - **For manufacturing facility, Industrial Development & Regulation Act did not allow foreign company to put pesticide plant in India.**
 - **Here comes one Mr. Dindayal, a liaison person from MP's capital city Bhopal.**
 - **A via route is worked out. Pesticide factory at Bhopal will be made in the name of Mr. Dindayal & he will pay TECHNICAL SERVICE FEE to Union Carbide.**
 - **North east side of the then Bhopal city railway station, known as KALI MAIDAN was the site for SEVIN manufacturing plant Location was much surrounded by huge human settlement (Slum Hutments).**
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Union carbide & India

- **Initially MIC was to be imported. First lot of 16 drums containing 2600 kg came to Ajee Bunder away from Bombay port.**
 - **One drum leaked when was being unloaded from ship by a crane. Captain of the ship ordered crane operator to throw the drum in to the sea.**
 - **Two safety officers of UCIL Mr. Kamal Parikh & Mr. Saqueel Qureshi noticed this.**
 - **Mr. Parikh shouted & kept the drum aside. With safety precautions, putty was applied**
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The Plant



Starting of the Factory

- The factory was started in 1969 as UCIL, with 51% of the share with UCC and the rest with Indian investors.
 - The initial crew were taken to the UCC plant in West Virginia and was given a training. There the safety manuals and standard operating procedures for the plant were made and the crew were trained on the same under the guidance of the .
 - The plant was started with the well trained staff as a smaller version of their plant in West Virginia.
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Operation

- In UCIL methyl amine was reacted with phosgene (also a deadly gas & chemical warfare agent) to form MIC, the MIC was then reacted with 1-naphthol to form the final product. This route is different to the MIC free route used elsewhere with the same raw materials in a different manufacturing order: phosgene is reacted with the naphthol first to form a chloroformate ester which is then reacted with methyl amine which was comparatively safer.
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The 1980s.....

- The MIC required to manufacture SEVIN and TEMIK were imported from USA initially but in 1979 UCIL made a MIC plant in the existing premises denying the offered site outside the town.
 - The drought in the 1982 and 83 made the sales very down. Sales was down even during the monsoon in the 1984.
 - The over produced MIC was stored in the storage tanks.
 - The drop in sales made the company have strict cost cutting measures (including a reduction in 335 man power) and made a savings of \$1.35 million in the year 1983.
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The 1980s.....

- Mr. Chakraborty a chemical engineer turned Finance professional was assigned the charge of helping in cost reduction. Under his single sided instructions most of the crucial systems were stopped.
- The measures taken in that included strict cutting in the maintenance cost, shut down of the refrigeration plant to keep the MIC at 4.5 deg C, changing several of the SS pipe line which were corroded with CS pipe line.
- Accidental leakages were very frequent from various plants the management asked the workers to develop an immunity by taking 6-7 glasses of milk daily and having a rich diet consisting eggs, meat and fish.
- The personnel management policy led into the flight of the skilled workers. They were replaced with uneducated workers.
- Safety training was cut down from 6 months to 15 days.

The 1980s

- The safety manuals were re written to allow the shutting down of the refrigeration system and vent gas scrubber when the plant was not in operation.
 - The manuals were written in English and most of the competent people have left and the remaining workers were unable to read the manuals.
 - The manpower in MIC plant was reduced from 12 to 6. Leaving one operator to monitor the 70+ panels.
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The warnings

- A series of prior warnings and MIC-related accidents had occurred:
- In 1976, the two trade unions reacted because of pollution within the plant.
- In 1981, a worker (Ashraff Khan) was splashed with phosgene. In panic he ripped off his mask, thus inhaling a large amount of phosgene gas; he died 72 hours later.
- In January 1982, there was a phosgene leak, when 24 workers were exposed and had to be admitted to hospital. None of the workers had been ordered to wear protective masks.
- In February 1982, an 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.
- In October 1982, there was a leak of MIC, methylcarbaryl chloride, chloroform and hydrochloric acid. In attempting to stop the leak, the MIC supervisor suffered intensive chemical burns and two other workers were severely exposed to the gases.

The warnings

- During 1983 and 1984, leaks of the following substances regularly took place in the MIC plant: MIC, chlorine, monomethylamine, phosgene, and carbon tetrachloride, sometimes in combination.
 - Reports issued months before the incident by scientists within the Union Carbide corporation warned of the possibility of an accident almost identical to that which occurred in Bhopal. The reports were ignored and never reached senior staff.
 - Local Indian authorities warned the company of problems on several occasions from 1979 onwards. Again, these warnings were not heeded.
 - One local reporter Mr. Rajkumar Keswani has visited the plant secretly and has interviewed the workers and based on the report has written several articles in the local hindi daily “Janasatta” which also were ignored.
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The warnings

- In the midst of this clamor, in May 1982, Union Carbide sent a team of U.S. experts to inspect the Bhopal plant as part of its periodic safety audits. This report, which was forwarded to Union Carbide's management in the United States, speaks unequivocally of a "potential for the release of toxic materials" and a consequent "runaway reaction" due to "equipment failure, operating problems, or maintenance problems." In fact, the report goes on to state rather specifically: "Deficiencies in safety valve and instrument maintenance programs.... Filter cleaning operations are performed without slip blinding process. Leaking valves could create serious exposure during this process." In its report, the safety audit team noted a total of 61 hazards, 30 of them major and 11 in the dangerous phosgene/MIC units. It had warned of a "higher potential for a serious incident or more serious consequences if an accident should occur." Though the report was available to senior U.S. officials of the company, nothing was done.
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2nd and 3rd Dec 1984

In the early hours of December 3, 1984, about 45 tones of methyl iso cyanate (MIC) gas leaked from the Union Carbide India Limited (UCIL) plant in Bhopal. According to the state government, approximately 3,800 people died, approximately 40 people experienced permanent disability, and approximately 2,800 other individuals experienced partial disabilities

2nd and 3rd December 1984

- In the evening of 2nd December, at 8.30, some workers were told to clean the pipes with water. There was no instruction to put in slip binds, so that water could not pass into connecting lines. Because of grossly inadequate maintenance, valves were malfunctioning and thus permitted water to pass even through closed valves. As tank 610 was not holding the pressure, it was possible for large amounts of water to enter the tank this way. The vent lines were made of carbon steel and handling corrosive substances, which would contaminate the tank 610, and catalyse the reaction.
- When water and contaminants reached the 43 tons of MIC, an exothermic reaction started which caused catalytic trimerisation (a runaway reaction). The temperature and the pressure increased and steam escaped in at least two places. The leakage continued for three hours, until the tank was empty at about two o'clock in the morning.
- Neither the workers nor the management did understand how serious the situation was. The first signs of the leak was noted 11.00 PM. At 12.15 AM, the supervisors considered the leakage as “normal” but ordered a water spray onto the leaking point. The water washing of the lines was stopped only at this time.

2nd and 3rd Dec 1984

- There was three double walled partly buried SS tanks each having a capacity of 60 Tonnes and all were filled with MIC which was used to produce a deadly pesticide Carbaryl having a trade name Sevin.
 - The night shift staff of the UCIL took a round at 11 pm on 2nd Dec.
 - At around 11:30 P.M workers eyes began to water. They have realized that MIC is leaking some where.
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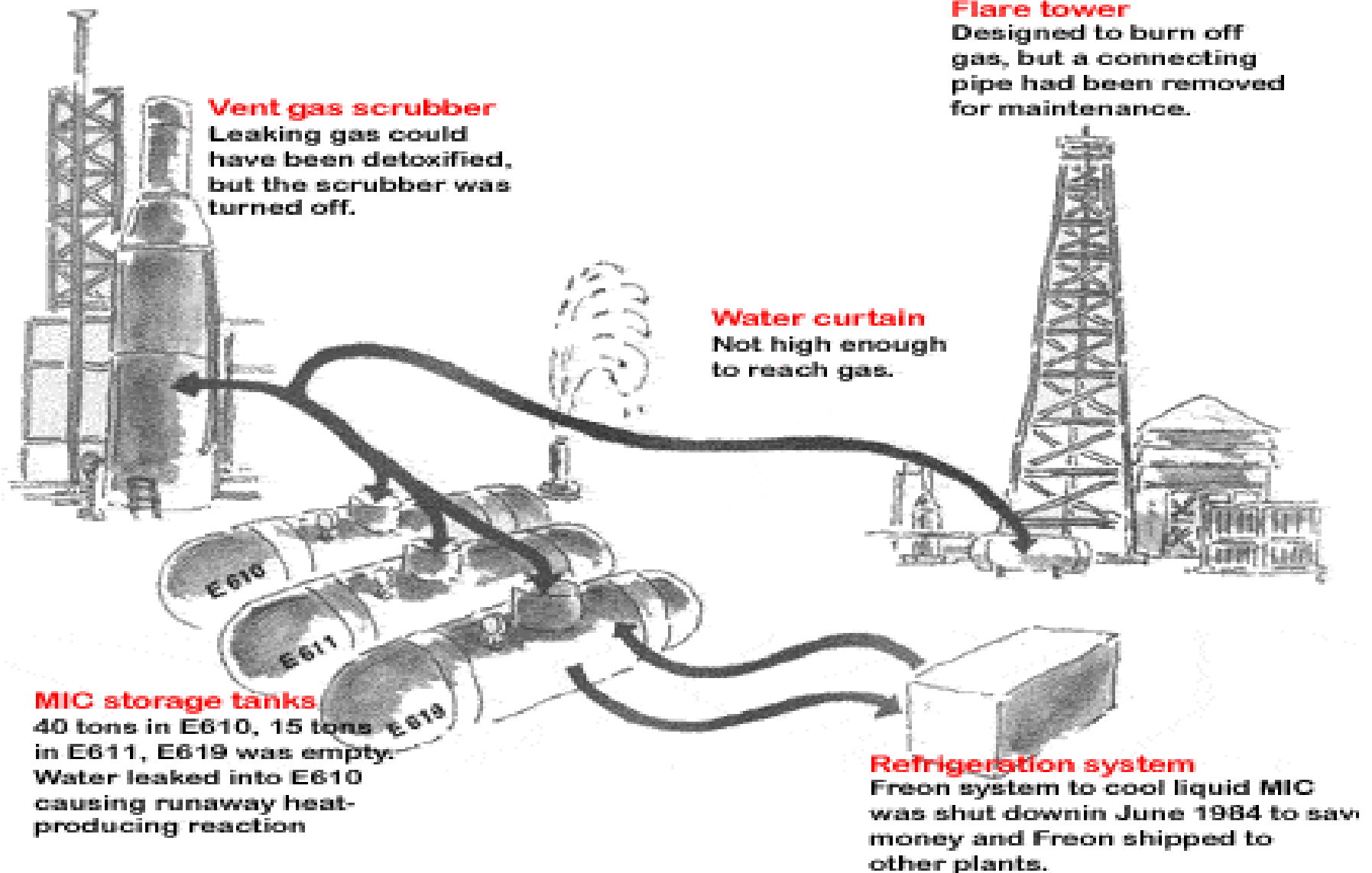
2nd and 3rd Dec 1984

- Some workers went to the MIC structure and noticed a drip of liquid with yellowish white gas about 50 feet off the ground.
 - They informed the supervisor about their observation.
 - The supervisor decided to attend the situation after the tea break.
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2nd and 3rd December 1984

- At 12.50 AM the alarms began inside the factory, and at 1.00 AM the loud siren was stopped. It was not restarted until 2.00 AM, fifteen minutes before the leakage stopped to avoid a panic among the residents, which prevented them from escaping.
 - By the time thousands of people were affected.
 - The hospital staff were baffled as they were not aware of the effects of the MIC and the antidote Sodium thiosulphate was not known to the staff in the company and the local hospitals.
 - The Police and Fire department who came to help were turned down by telling there is nothing major just a gas leak.
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Emergency mitigation systems.



Some more failures.....

- The VGS was under designed and was in maintenance so not connected to the line
 - The corroded flare tower pipe was not replaced and was not connected.
 - The water curtain jets were under designed to reach the maximum height.
 - The gauge showing the pressure of the inert gas in the tank was showing Zero for long time it was ignore thinking that the gauge is faulty.
 - The temperature sensing system was not installed in the tank.
 - No wind direction or velocity indicator was installed
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Some more failures.....

- The neighbouring community were not told about the actions to be taken when they listen a siren even after a previous incident of gas leak.
 - The supervisor who instructed the operator for washing the line with water didn't asked him to install slip blinds.
 - Though the audible external alarm was activated to warn the residents of Bhopal, it was quickly silenced to avoid causing panic among the residents. Thus, many continued to sleep, unaware of the unfolding drama, and those that had woken assumed any problem had been sorted out.
 - A warning was issued by the scientists in the Union Carbide in Sept 1984 in their OH&S survey report but it was not taken seriously and was not communicated to the Bhopal plant.
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Result.....



Result.....



Results...



Lets not have a BHOPAL again....
