International Dimensions of Ethics Education in Science and Engineering
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Bhopal Plant Disaster – Situation Summary

by MJ Peterson
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During the night of 2-3 December 1984, a leak of some 40 tons of methyl isocyanate (MIC) gas mixed with unknown other gasses from a chemical plant owned and operated by Union Carbide (India) Limited, a partly-owned subsidiary of the US-based Union Carbide Corporation, caused one of the highest-casualty industrial accidents of the 20th century. At least 2000 people died immediately and another 200,000 to 300,000 suffered respiratory and other injuries of varying severity. Property damage consisted mainly of contamination to nearby areas by various chemical residues. The defoliation of trees immediately afterward is clearly attributable to the gas leak; contamination in the nearby settlements may have multiple sources, the contamination of the plant site resulted from many years of general production activity.

India's Economic Ambitions

When India attained independence from Great Britain in 1947, its new political leaders wanted to make the country wealthier by encouraging development of modern industry. It had strong support from the citizens, who generally agreed that India's current lack of industrialization and economic development were the result of these colonial-era policies. Thus the new government could expect widespread support for any policy that appeared to set the country on the path to industrialization. The new political elite brought to this task a set of beliefs about economic policy that sought a middle way between the heavy reliance on private enterprise that had characterized British industrialization in the 18th and 19th centuries and the reliance on central planning of the whole economy characteristic of the Soviet Union's industrialization effort since 1917. The combination of welfare state and mixed economy developed by Indian leaders was very similar to Western European ideas of the period.

Indian political leaders, like their Western European counterparts, believed that private enterprises were too focused on profitability of the firm to undertake the economic reorganization needed for assuring broad-based prosperity and, in primarily agricultural countries like India, the transformations needed to introduce modern industry. Both believed that only a mixed economy, in which state-owned enterprises operated the major sectors of the economy and private enterprise guided by considerable government regulation to protect workers and the general public, would successfully meet the economic challenges facing the country. In India, steel-making, railways, shipping, aviation, and electrical power generation were the most

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prominent industries dominated by state-owned firms; the nascent Indian chemical industry was a mix of state-owned and private firms.

In its Resolution on Industrial Policy in 1948, the Indian government expressed a strong preference for Indian enterprise, but indicated willingness to allow some collaboration with foreign firms:

> … while it should be recognized that participation of foreign capital and enterprise, particularly as regards industrial technique and knowledge, will be of value to the rapid industrialization of the country, it is necessary that the conditions under which they may participate in Indian industry should be carefully regulated in the national interest. Suitable legislation will be introduced for this purpose.

The follow-up legislation included limits on foreign shareholding in Indian firms, so that multinationals could not own 100% of their Indian subsidiaries but had to share ownership with Indian nationals. It also preferred collaboration only when the foreigners owned technology not available in India. The government hoped to determine the terms on which Indians could acquire technology by law, but its early preference for importing "at the lowest cost" and not paying license fees on imported technology for more than 5 years (typical patent protection lasts 20) had to be modified in the face of foreign companies' unwillingness to make deals with Indian firms (state-owned or private) on those terms. Thus the Indian government fell back on a system of requiring that subsidiaries of foreign firms be part-owned by Indian nationals, that the Indians be trained in all aspects of firm operations and technologies, that any business operation using foreign technology be licensed by the state, and that the government specifically approve the type and duration of employment of foreigners hired as managers, technical specialists, or workers.

The Company and the City

Union Carbide (India) Limited (UCIL) operated in India even before independence, primarily as a maker and seller of dry cell batteries under the "Eveready" trademark also used in the USA by Union Carbide. UCIL expanded into making fertilizers and pesticides in the 1960s as the government encouraged local production to supply farmers with the chemicals needed to raise the new hybrid types of rice, wheat, and cotton. India had suffered serious food shortages in the early-mid 1960s because of drought, and the greater drought-resistance of the new hybrids made them very attractive to a government concerned with feeding a growing population and increasing the supply of locally-grown cotton for the growing textile industry.

When UCIL established its Agricultural Products Division in the mid-1960s, the largest concentration of Indian chemical plants was located in Chembur near Bombay [Mumbai], an area called "gas chamber" by residents because of the extensive air pollution. There was relatively little industry in Bhopal, but both the central government and the state government of Madhya Pradesh, of which Bhopal is the capital, were anxious to bring industry to the area. Thus UCIL's plans for a chemical plant and an agricultural products R&D center met with a favorable reception, and the state government even supplied the land for the proposed chemical plant on a favorable 99-year lease. The UCIL plant brought with it good paying jobs,

not only for members of the growing technical stratum but for lower-level workers as well. UCIL executives maintained good relations with local political leaders as well.

In the 1960s and 70s, the rural population of Madhya Pradesh was increasing at a rate of 2% a year. Bhopal was one of the fastest-growing cities in India during the 1960s and 1970s as unemployed people from the surrounding countryside came looking for better opportunities, and the state government was anxious to have an industrial base. As in other Indian cities, growth was haphazard, and planning frequently followed after people had settled on an unoccupied area of land and built themselves improvised shelters. The resulting "hutments," as they are called in India, were usually narrow strips of ramshackle shelters with mud walls and wood or sheet metal roofs separated by narrow alleys located along already-constructed roads. They typically lacked basic infrastructure such as piped water, sewage, electricity (except where inhabitants could tap illegally into existing power lines), and access to public transportation. Even in the more established areas of town, infrastructure was weak. There were approximately 10,000 phones in the city, most in government offices, and they often failed to work. Electricity was unreliable and usually not supplied all day. In 1984 there were 1800 hospital beds and 300 doctors in the whole city.

When UCIL constructed the first elements of its plant in 1968-69, the population of Bhopal was approximately 300,000 and large portions of the area next to the plant were still uninhabited though it was about 2 miles from the center of the Old City and nearer to some established neighborhoods with hospitals and a railway station. As other industrial concerns located nearby, electricity was brought in to the plants, and supplied more reliably than in many parts of the city. These developments made the area more attractive to newcomers seeking employment, and the fact the state government owned much of the vacant land made the area particularly attractive to squatters and to people posing as landowners and "renting" huts to others because it was less likely than private owners to try displacing them.

City plans were developed in 1958-59 and 1962-63, but never implemented. In 1975, the Madhya Pradesh government adopted a new Master Plan for Bhopal designating areas for residential and other developments and establishing a "hazardous industry" district in an area about 15 miles from the center of town. UCIL had been formulating pesticides (taking concentrates and diluting them to the strength needed for use on farms) at its plant since 1969 and in October 1975 secured a license from the central government to produce up to 5,000 tons of "SEVIN," a carbaryl pesticide, using a methyl isocyanate-based process. This would require adding new facilities in the existing compound and undertaking more complicated production processes. Even so, the state planning board classified the plant as "general industry" rather than "hazardous industry" in a 1976 review. This decision allowed both current activity and the new construction to go ahead at the existing location.

Population growth continued, and the 1981 Indian census put the population of Bhopal at about 896,000. In April 1984, with the city population estimated at 900,000, the state government gave in to the accomplished fact of settlements near the UCIL plant by distributing certificates confirming squatters' ownership of approximately 50 square meters (500 square feet) of land where their hut stood. This decision had several motives: the party in power's desire to secure electoral support in future elections, a realization that the settlers could not be moved, and a desire to reduce the amount of extortion they suffered from persons posing as landowners. Though many in the area had already tapped into the electric

grid illegally, neither the state nor the city government made any plans to extend piped water or sewers into the area, or to address the significant industrial and residential pollution of the nearby lakes.

The Economic Situation of the Chemical Plant

The UCIL plant succeeded as a chemical formulary, a simple operation in which high-concentrate versions of fertilizers and pesticides are diluted and packaged for customer use. Company efforts to realize its, and the Indian government's, ambitions to have the plant move on to full production of chemicals were dogged by problems. UCIL's initial plans called for making local versions of Union Carbide's carbaryl pesticides using an alpha-napthol process its own chemists had worked out in 1969. However it proved much harder than UCIL expected to scale up to the volumes that would be needed to produce a pesticide on-site. The first version of the alpha-napthol unit failed soon after construction was completed in 1978, and an additional US$2 million was spent on rebuilding it. The reconstructed unit also failed soon after its completion in 1981. The plant had to import alpha-napthol from Union Carbide.

After reviewing production costs in 1981, Union Carbide suggested that UCIL should import the methyl isocyanate as well, but the Indian government, which had approved the project in the expectation of getting local production, rejected the application to import MIC and established a January 1985 cutoff date for alpha-napthol imports as well. This effectively established a tight deadline for getting the process to work. By 1982 as construction of the methyl isocyanate unit was moving to completion, UCIL and Union Carbide both realized that the plant was not economically viable because of changes in the market. Local demand for UCIL's pesticides had dropped significantly after 1977 as Indian farmers shifted to cheaper local products. New generation carbofuran pesticides under development in the USA and Western Europe appeared likely to render "SEVIN" obsolete at the upper end of the market. Though the Bhopal plant returned a modest profit in 1981, it operated below capacity and at a loss afterward. Discussion of various alternatives between UCIL and Union Carbide in 1982-84 led UCIL to accept Union Carbide suggestions for selling all or most of the plant. By fall 1984 it was operating at about 1/5 of capacity.

The Gas Leak

As UCIL and Union Carbide considered the fate of the Bhopal plant and losses continued, the quality of its operation deteriorated. The initial Indian managing and supervisory staff for the Bhopal methyl isocyanate production unit were trained in Union Carbide's West Virginia plant in 1981-82. As the Bhopal plant's prospects declined, they began leaving for more attractive jobs and were replaced by less-skilled employees. Low production volumes seemed to justify reductions in the workforce though the local labor unions insisted that they were going too far. In the methyl isocyanate unit, the workforce was reduced from the Union Carbide-recommended 3 supervisors and 12 workers on each shift to 1 supervisor and 6 workers. Other areas of the plant were also affected by reductions. Labor-management relations had been rocky since a fatal gas leak in December 1981, and the workforce reductions did not improve matters.

In the late fall of 1984, plant operations were focused on using up existing stocks of chemicals to prepare for sale of the plant. In October, the remaining stocks of phosgene and methyl amine were combined to make about 62 tons of methyl isocyanate which was then stored. About 22 tons were put into Tank 611

and the rest in tank 610. Plans to draw off the MIC one ton at a time and make the last batches of SEVIN were soon disrupted. On October 31st rioting broke out in several parts of Bhopal after news that Prime Indira Gandhi had been assassinated by some of her Sikh bodyguards reached the city. City authorities imposed a curfew for several weeks. The resulting difficulties in getting the second and third shift of workers into and out of the plant limited activity for much of November. Production was also hampered briefly by inability to pressurize Tank 610, but resumed when operations shifted to drawing from Tank 611.

In the evening of 2 December, the second shift supervisor ordered workers to perform a periodic washing of pipes in the MIC storage area to control corrosion. As this operation began about 9.30 pm, most of the safety systems in the plant were not in good operating order. The vent scrubber, designed to neutralize any gas leak through the vent with caustic soda, was on standby and appeared ready for operation. The flare, which would handle larger leaks via flame neutralization, lacked sufficient capacity to deal with a major leak. It had been shut down a few weeks earlier for replacement of a corroded pipe, and all relief pipes in the plant were directly connected to the gas vent scrubber. The refrigeration system designed to keep MIC storage tanks cool, had been turned off several months before and the freon drawn off for use elsewhere in the plant. The firewater spraying systems designed to deal with fires, cool down overheated equipment, or provide supplementary water neutralization of gasses was operational but the spray could not reach the top of the flare stack. The high pressure escape valve, which would release if pressure in the tank exceeded 40 psi, and shunt gas to the vent or the flare was operational.

In the generally accepted account of events, the washing operations proceeded despite a) failure to insert a slip blind into the pipes to make sure that water did not back up into storage tanks and b) the fact one or two of bleeder valves at the bottom of the pipes where wash water should have come out were blocked. The worker doing the washing noticed this, and suspended washing to report the problem. His immediate superior, an operations supervisor rather than a maintenance supervisor, told him to continue. The blockage caused water to back up. This was not detected, and washing continued after the third shift comes on at 10.30-10.45 pm. Water than began entering Tank 610 by passing through a normally-open pressurization valve and then through a partly-open isolation valve that should have been closed after the last draw of MIC but was not because of either human error or mechanical failure. By 11 pm, the control room pressure indicator for Tank 610 read 25 psi, up from 2 psi earlier in the evening. However this was within normal fluctuations so did not cause alarm. Worker concern was first inspired by the small of gas about 11.30. A small leak was found and a water spray set up to neutralize it. Workers discussed the situation and what to do during their regular 11.30 pm tea break. Pressure continued to build relatively slowly, with the control room indicator reading somewhere between 25 and 30 psi at 12.15 am. By 12.30 am, however, it read 55 psi – well above operational limits and gauge error.

At this point the control room operator went out to the tanks to double-check the gauges there. He heard a relief valve pop, heard rumblings from the underground tanks, and felt heat through the concrete covering the tanks. He returned to the control room to engage the stack scrubber, but the caustic soda failed to flow. A large cloud of gas escaped from the vent stack. At about 12.40 am the plant supervisor was informed of the problem and the alarm sirens sounded. However the sirens audible outside the plant were shut off after a few minutes. Efforts to reduce the danger by transferring liquid MIC to another tank failed because the alternate tank was not empty as supervisors initially believed. Efforts to neutralize the escaping gas with

water also failed because the spray could not reach the top of the vent stack. Thus gas leaked out for about 2 hours. The amount of gas escaping is usually put at 40 tons.

Residents of nearby areas begin smelling the gas about 1 am. Lack of information about what to do induced panic and people began to flee. The Bhopal police were poorly organized and did little to help immediately after the leak. An army engineer unit mobilized after a personal request to its commander by a retired officer now running an industrial plant near the UCIL plant, evacuated that plant's workers at about 3 am and then began transporting local residents to hospitals and clinics. Medical staff converged on their hospitals and clinics as they heard about the situation, but their initial efforts to treat patients were hampered by lack of information about the gas or antidotes. Inquiries to UCIL medical officers yielded little specific information and downplayed MIC hazards.

Impacts

Though there was defoliation of trees and some additional contamination of soil and lakes, the main impact of the accident was death and injury to humans and animals. Estimates of the number of immediate human deaths caused by the Bhopal gas cloud wary from the official Indian government figure of approximately 2000 to the 10,000 favored by local activists. The number treated for gas exposure and continuing to suffer ill-health over the next several years has been estimated at 200,000 to 300,000, and by 1990 when the government of Madhya Pradesh provided the Supreme Court of India with a list of victims eligible for compensation, 3,818 persons were listed as dead from the effects of gas exposure. Additional thousands were made sufficiently ill to be unable to work. Medical treatment of survivors was complicated by lack of knowledge about what gasses escaped the plant, the paucity of information provided by Union Carbide and UCIL, the general lack of information about the longterm (as distinct from immediate) effects of high exposure to MIC or related gasses, and uncertainty about what toxic chemicals other than MIC had poisoned the victims. The deaths also led to considerable disruption of family lives as widows and orphans joined households of relatives. Since most of these households were very poor, the strain of extra mouths to feed was considerable, particularly for families taking in survivors who needed continuing medical care.

Locally and globally, blame for the accident was quickly assigned to Union Carbide. Consistent with widespread beliefs that multinationals control their subsidiaries' operations very closely, it rather than UCIL was deemed ultimately responsible for the condition of that plant and the level and training of staff. In Bhopal itself this sentiment was assisted by an influx of US lawyers seeking to sign up clients for lawsuits against Union Carbide in the USA; in other parts of the world Union Carbide's weak safety record made it a target for general frustration about the lack of transparency about chemical company operations and a focal point for environmentalist mobilization. This was intensified in 1985 as a string of smaller gas leaks at the West Virginia plant made the news and the US government investigated conditions at the plant.

Though it was clear immediately that Union Carbide and/or its executives would face criminal and tort charges in India, investors imposed penalties far more quickly. Standard and Poors dropped the company's credit rating to the lowest investment grade while institutional investors (universities, pension funds, mutual funds) dumped shares enough shares for their stake in the firm to decline from 65 to 35%. By December 1985, some 30% of Union Carbide stock was owned by rival companies or speculators

poised for a hostile takeover. The company spent the next several years fending off takeover bids, most often by selling its more profitable divisions to raise the money needed, while also required to set aside funds for payment of legal settlements. It sold its 50.1% stake in UCIL to an Indian firm in 1994, with the proceeds going to build and endow a hospital for gas victims in Bhopal. The last remnants of Union Carbide were absorbed by Dow Chemical Company in 2001.

Victims filed lawsuits against both the company and the Indian government (citing its failure to regulate effectively) in India and the USA during early 1985. To deal with the proliferation of claims the Indian Parliament adopted special legislation in March giving the government sole authority to sue on behalf of victims, and the government filed its own lawsuit in US courts. The US courts consolidated the several thousand private claims and the Indian government suit into a single case, which was heard in the Federal District Court for the Southern District of New York. Efforts to negotiate a settlement foundered on Indian government objections to the amounts offered by Union Carbide, and the suit went to trial. The initial US hearing focused on admissibility of the lawsuit since the events had occurred in India and international legal norms usually favor trial in the place where events occurred. The Indian government and the lawyers for individual claimants argued strenuously for a US hearing while Union Carbide argued equally strenuously for dismissing the case in favor of hearings in Indian courts for the same reason: US courts allowed greater opportunities for class action suits and were likely to award higher compensation to the victims. Yet in a decision interpretable either as deference to the Indian legal system or a victory for Union Carbide, the US District court ruled that the lawsuits should be heard in India.

Efforts to negotiate a settlement continued, with the Indian Supreme Court pressing the sides to come to a global settlement of all cases. They agreed on compensation of $470 million, a settlement a panel of the Indian Supreme Court approved and ordered the parties to carry out. The settlement aroused considerable opposition as it fell far short of the $3 billion that victims' advocates were seeking, and appeal was made to the full Supreme Court. It affirmed the decision in 1991, adding a provision requiring Union Carbide to fund building of a hospital in Bhopal to treat surviving victims. Only in 2003 did the Government of India complete paying compensation to victims, at which time a new dispute arose over what to do with the approximately $390 million remaining after compensation was paid (the money having earned interest between 1989 and the payout). The Indian Supreme Court ordered the government to release this to programs for victims.

This settlement did not cover the related question of liability to clean up or pay for cleaning up the plant site. Union Carbide and UCIL performed some cleanup work under Madhya Pradesh supervision in 1986-98. UCIL's successor turned the land back to Madhya Pradesh in 1998, and all work put under state authority. Efforts to file class action suits in the USA to compensate victims of later exposure to contamination and to secure money for cleanup of the plant site were initiated in 1999 and 2007. The 1999 suit was rejected in 2004 and 2005, and the 2007 suit suspended pending the outcome of appeals against those rulings. UCC's and UCIL's successor companies, Dow Chemical in the USA and Eveready Industries in India (mainly the former), are now the targets of transnational campaigns on behalf of the victims.

For anti-corporate and anti-capitalism activists, "Bhopal" has become shorthand for corporate greed and callousness. For the victims and their supporters, the word conjures up continuing inaction by their own

government as well. The accident also inspired considerable discussion of need for better regulations addressing chemical plant safety, information about toxic chemicals, and contingency planning for mitigating the impact of gas leaks inside and outside plants. In Western Europe, this process was well-advanced in reaction to the 1976 Seveso gas leak in Italy. Policy initiatives were more numerous in the USA, particularly after a significant leak from Union Carbide's MIC plant in West Virginia in early 1985 sent local residents to the hospital. Reaction was less strong in India, where environmental law was less developed and citizen environmental movements weaker.

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Bhopal Plant Disaster
Appendix A: Chronology

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References used in this section:

Paul Srivastava, *Bhopal: Anatomy of a Crisis* (Cambridge, MA: Ballinger, 1987).

Sanjoy Hazarika, *Bhopal: The Lessons of a Tragedy* (New Delhi: Penguin Books India Pvt Ltd, 1987)

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Bhopal Chronology

The timeline below documents the incidents leading up to and resulting from the 1984 Bhopal Plant Disaster. Use the key below to quickly find information on government measures relating to specific organizations, Indian national legislation, casualties, and economic conditions and profitability. A timeline documenting ensuing legislation can be found at the end of the main chronology.

Key

brown = central (India), state (Madhya Pradesh), or city (Bhopal) government measures relating specifically to UCC, UCIL, Bhopal plant, or immediate neighborhood of plant

green = general India national legislation relevant to conduct of business

red = casualty-producing plant incidents

violet = economic conditions relevant to Bhopal plant profitability

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UCIL= Union Carbide (India) Limited

UCC= Union Carbide Corporation

1956 Indian Parliament adopts Companies Act of 1956 which requires affiliates of foreign companies to register as separate companies under Indian law and imposes limits on foreign investment and participation in all Indian companies.

Union Carbide reduces its share of ownership in its Indian subsidiary (then called National Carbon Company (India) Limited from 100% to 60% in accordance with new Indian law by registering as an Indian company and selling shares to Indian citizens. All but one or two UCIL board members, all UCIL executives, and all regular or seasonal employees are Indian nationals.

1966 Indian market for fertilizers and pesticides is expanding as government adopts a range of policies, including efforts to increase yields and reduce post-harvest losses of crops to pests, to make India self-sufficient in food. India had depended heavily on outside food aid in earlier part of the decade, and government wished to end this. The domestic production of pesticides in 1966 is 14,000 metric tonnes, well short of what government wants to supply to farmers.

Union Carbide India Ltd (UCIL) establishes a new Agricultural Products Division to take advantage of growing Indian market for fertilizers and pesticides. Initial activity involves local formulation (diluting “technical grade” concentrate to make sale products) only.

UCIL applies for license to carry out the whole production process in India.

1968 Government of India approves UCIL plans to build fertilizer/pesticide formulation plant in Bhopal. State of Madhya Pradesh leases land in the Kali Parade area of Bhopal for the plant to UCIL on a 99-year lease. Area around plant is relatively unpopulated at time though there are two lakes and a railroad station nearby. Total population of City of Bhopal is estimated to be about 300,000.

Adoption of India's 4th five-year plan, to run 1969-74. Plan goals include reducing "unwholesome dependency on foreign agencies," particularly foreign corporations. The Plan outlines goals of requiring foreign investors to enter into joint ventures rather than establish wholly-owned subsidiaries, and reaffirms requirements to train and employ Indian nationals at all levels of operation, to use made-in-India equipment and components whenever they are available, and to transfer technology to Indian affiliates.

1969 Bhopal plant begins operating. Initial operations are making raw fertilizer and formulating (diluting to usable strengths) pesticides with US-origin "technical grade" chemical concentrates. UCIL industrial chemists develop a method of producing alpha-napthol that UCIL anticipates being able to scale up to economically competitive production volumes.

1970 UCIL is reconsidering its business plan as the large-scale making of alpha-napthol turns out to be more challenging than it anticipated.

1972 Government of India presses UCC and UCIL to have UCIL plants shift from formulation using US-source chemicals to full production in India. Makes operating license for Bhopal plant conditional on using domestically-made alpha-napthol.

Government of India establishes National Committee for Environmental Planning and Coordination.

1973 Indian Parliament adopts Foreign Exchange Regulation Act 1973. Among other strong controls on flows of money in and out of India it establishes a scheme for government control over Indian firms' decisions on hiring foreigners as employees or contractors.

Indian Government approves UCC-UCIL Design Transfer Agreement and Technical Services Agreement under which UCC will provide the basic process design of a plant capable of producing SEVIN (a carbaryl pesticide used on cotton and other crops) and training for Indian operators of plant. Design Transfer Agreement limits UCC to provision of the process design and materials specification. Detailing the design and building the plant are to be undertaken by Indians nationals employed by or contracting with UCIL. Government also uses powers to license technology imports to guide selection of suppliers of components for plant to Indian firms as much as possible.

Engineers employed by UCIL who will be involved in plant design visit UCC Technical Center in West Virginia to earn about US plant specifications and start process of adapting them to India's conditions.

1974 Indian Parliament adopts legislation requiring that Indian companies partly owned by foreigners reduce foreigners' ownership share. For companies with 60% foreign ownership, the new legal maximum is 50.9%. UCIL complies by the end of 1978 through sale of additional shares of stock offered only to Indians.

Indian Parliament adopts Water (Prevention and Control of Pollution) and Air (Prevention and Control of Pollution) Acts. These establish the central government as the main standard-setter while leaving enforcement to state governments. Both Acts increase penalties for causing pollution but do not specify any emissions or ambient standards.

1975 New Master Plan for City of Bhopal establishes a separate district for "hazardous industry" in an open area 15 miles from center of town.

31 Oct Indian Government licenses UCIL to produce up to 5,000 tons of carbaryl pesticides a year in Bhopal plant

UCIL hires Humphreys and Glasgow Consultants Private Limited, an Indian subsidiary of London-based Humphreys and Glasgow, to detail the plant design and supervise construction.

1976 Madhya Pradesh Town and Country Planning Board classifies UCIL plant as "general industry" rather than "hazardous industry." This allows plant to stay in its established location rather than move to the hazardous industry zone.

1977 Bhopal plant begins production of pesticides and begins $2.5 million project to expand alpha-napthol production unit to accommodate Sevin production.

India hit by drought; farmers need loans from government to ride out the loss of harvests, cut back on pesticide purchases.

1978 New alpha-napthol unit's components fail soon after startup. $2 million reconstruction project begun.

Production of pesticides continues using alpha-napthol imported from UCC's US plants.

UCC and UCIL decide to shift Bhopal plant to methyl isocyanite (MIC) process to produce SEVIN because parent UCC regarded this process as more economical and efficient than previous way of producing it. New Bhopal MIC unit based on design of UCC's MIC unit in Institute, West Virginia. (See separate page on alternative methods for production of SEVIN or similar carbamate pesticides.)

winter Progress review of Bhopal project at UCC headquarters. Concerns about cost of building plant and reduced estimates of potential pesticide sales lead to consideration of whether Bhopal project can be scaled back. Decision is to continue as construction is too far advanced.

	24 Nov	Welding spark ignites nearby chemicals because welder unaware of and supervisor did not point out nearby flammables. No injuries; Rs. 6.2 million ($730,000) in property damage.
1978-79		20 UCIL engineers sent to UCC's West Virginia MIC plant for training in plant operation and safety.
1979		UCC engineers sent to India for pre-startup inspection of Bhopal plant report multiple deficiencies in safety measures. They also advise UCIL management of need to develop contingency plan for alerting and evacuating nearby population in event of major gas leak. UCIL management later reports it had developed such plans; city and state government officials claimed in 1984 that they were not aware of any such plans.
	June	UCC Eastern Division brings up question of Bhopal plant at a global strategy meeting because of concern that it, like Institute WV plant, is too large for the market. Proposals to export part of Bhopal plant's production are not adopted because of potential negative effects on other UCC subsidiaries.
		UCC sends 8 US engineers and technicians to Bhopal plant to assist with startup and early operation of MIC unit.
1980		Government loans to farmers come due. Farmers shift to less expensive pesticides. Many of the newer pesticides are synthetic pyrethroids that are also safer in Indian conditions than carbaryl types like Sevin.
		Indian Government upgrades National Committee for Environmental Planning to cabinet-level Department of Environment. Both national and most state governments (including Madhya Pradesh) have Pollution Control Boards to inspect and enforce environmental laws.
	March	Government approves UCIL application to retain 1 UCC engineer through 31 May 1981; renews approval through 31 May 1982 and then to 31 December 1982.
		7 of the 8 UCC engineers and technicians sent from West Virginia return home. The remaining engineer continues to serve as plant manager until June 1982, then remains as a consultant.
	Fall	A second UCC engineer team visits the Bhopal plant and repeats warnings about lack of contingency plan.
1981		Rebuilt alpha-napthol unit started up; fails again and is shut down. Alpha-napthol imports continue.
		Bhopal plant returns a modest profit for the year.
		National census puts City of Bhopal population at 700,000. Significant populations of recent arrivals from the countryside have settled in shanty towns near UCIL plant.

June UCIL/UCC review of Bhopal plant operation shows that the variable cost of producing alpha-napthol in Bopal is 4x the US cost and the variable cost of producing SEVIN in Bhopal are 3.5x US costs. UCC and UCIL are both aware that new-formula pesticides coming onto market in India and other countries are likely to reduce demand for SEVIN.

UCC wants UCIL to import MIC from UCC plant in West Virginia; Government of India refuses permits because it wants the making of MIC undertaken in India.

24 Dec 1 supervisor and 2 workers exposed to phosgene leak during a maintenance operation; one of the workers dies from effects of phosgene inhalation. UCIL management says he was at fault for removing his gas mask; workers claim supervisors gave insufficient warnings. Accident reported to UCC; UCC response plan includes additional training and some design changes.

1982

10 Feb 25 workers injured when a pump seal fails and significant quantities of MIC, phosgene, and hydrochloric acid gases escape into plant. Some treated on-site; 16 sent to local hospital

Feb Workers help a local journalist get into plant; he observes and writes about poor condition of plant and lax safety routines. Paper publishes story but warnings that a massive leak is likely are ignored.

India Labor Department investigates the Dec. 1981 fatal accident and recommends corrective measures.

Bhopal plant is operating at less than half capacity because of weak market for its products. Local competitors making cheaper pesticides continue gaining market share.

Spring Either UCIL asks UCC to send engineering team to inspect plant, or UCC does on own initiative (accounts vary, usually consistently with author effort to show UCC was or was not in close control of plant during the post-disaster litigation).

22 April 3 electricians suffer minor burns when one drops a screwdriver into an electrical panel and it short-circuits. State inspectors recommend better insulation of circuits.

May UCC engineers inspect Bhopal plant, issue Operational Safety Survey on conditions in plant, warn there is real danger of a runaway reaction; suggest measures to avert danger

UCIL management reports to UCC on follow-up, saying will accomplish all measures but do not act on the recommendation to increase the range of the firewater spraying system from 15 meters to 35 meters so it can reach the top of the MIC vent pipe. The last UCIL communication on followup, dated 26 June 1984, says all changes have been made except one to the SEVIN feed tank, which will be completed when the needed control valve is delivered in about a month.

Summer Jagannathan Mukund, Indian citizen trained at Institute WV plant, replaces US national Warren Woomer as plant manager.

UCIL has to admit failure of efforts to scale up alpha-napthol production; alpha-napthol unit shut down as too unprofitable to run. Worker transfers begin.

Aug Splash of liquid MIC at plant injures a chemical engineer

Sept UCIL applies for extension of its Foreign Collaboration Agreement with UCC through December 1987 so it can continue importing alpha-napthol.

Fall Indian government approves UCIL application for renewal of Foreign Collaboration Agreement with UCC, but only to 1 Jan 1985.

6 Oct Leaks of MIC, hydrochloric acid, and chloroform injure 3 workers seriously enough to require brief hospitalization; 15 others less affected are given first aid at plant. Some panic in neighboring shantytown. State inspectors note several violations of normal operating procedures and recommend measures including red tags on equipment that should not be used.

Labor unions complain to Madhya Pradesh Ministry of Labor about conditions in plant. Also begin occasional public demonstrations.

Madhya Pradesh state labor ministry inspectors inspect plant but they are mechanical engineers with limited competence to assess safety of chemical plants. Labor Ministry officials do enter complains with courts, but these will not be taken up for some time owing to long list of pending suits.

Madhya Pradesh minister of labor says the plant is safe and berates opposition for its worries during question time in a December session of the state legislature.

31 Dec Warren Woomer, the last remaining American employee, leaves Bhopal plant.

1983 Various cost-cutting measures undertaken. Staff morale declines through the year as layoffs and resignations take effect. Experienced workers leave and are replaced by less experienced workers from other units of Bhopal plant or other UCIL plants.

Madhya Pradesh State Pollution Control Board requires companies to declare what they are emitting into the air. UCIL declared carbon dioxide only, not the other gasses (including phosgene and MIC) that occasionally leak. Board lacks sufficient inspectors to follow up, even after animals die from drinking water from a stream just outside the plant polluted by fluid runoff from the plant.

Sept Chief of National Pollution Control Board visits plant area while in Bhopal. Orders UCIL to fix flaws in effluent evaporation pond that permit leaks onto adjacent land. UCIL complies.

Fall Proposal to salvage investment in Bhopal plant by converting part of it to produce new carbofuran pesticide and supply it to India and other markets are rejected as economically unfeasible by UCC.

Dec. Jumper pipe connected between pressure valve header and relief valve header on MIC tanks to simplify maintenance.

Bhopal plant manager Jagannathan Mukund given UCC safety award for operating 12 months without serious incident.

1984 Bhopal plant operating at 1/5 capacity owing to weak demand. Losses near $4 million since 1980.

Successive reductions in personnel mean only 1 supervisor and 6 workers are present on each shift in the MIC unit (company guidelines state that the MIC unit should have 3 supervisors and 12 workers on each shift).

Training of supervisors and workers has become less rigorous.

April Madhya Pradesh government legalizes the shanty towns that have grown up just outside UCIL plant since 1978 by granting dwellers certificates of ownership of the land they occupy. Bhopal population estimated to be close to 900,000 and the shanty towns are notably larger than they had been in 1981.

May UCC approves UCIL proposals to write off the alpha-napthol unit, sell rest of Bhopal plant while retaining MIC unit, reduce UCC ownership share of UCIL to 40% so UCIL can be more independent. Neither the UCC share reduction nor the plant sale had been carried out by December.

June or July Bhopal Town Planning Board lists 18 factories as “obnoxious” and therefore to be monitored particularly carefully. UCIL’s Bhopal plant was not included on the list.

Sept UCIL engineers inspect plant, report to UCIL top management that 1) gas scrubber is functioning poorly, 2) there are poor communication between plant production and maintenance staff, 3) workers lack instruction on what do in event of runaway reaction, 4) safety meetings are held only half as often as specified in company rules.

Sept UCC engineers survey conditions at UCC's Institute, West Virginia chemical plant. They report concerns about various aspects of the operation and condition of the plant. They also indicate conditions creating danger of a "runaway" gas reaction in the MIC storage tanks (larger than the ones installed in the Bhopal plant).

Oct UCC considers idea of dismantling Bhopal plant and shipping equipment to Brazil or Indonesia. Asks UCIL to draw up feasibility study and cost estimates. UCIL reports back 29 Nov. Question of what to do is pressing because the plant will have no source of alpha-napthol when UCIL’s Foreign Collaboration Agreement with UCC expires on 1 Jan 1985.

7-22 Oct Remaining phosgene and methylamine stocks at Bhopal plant are used up in making a last batch of MIC. 42 tons are put into Tank E610; about 20 tons into Tank E611. UCIL plan is to withdraw it a ton at a time In November and December and react it with alpha-napthol to produce SEVIN. MIC production unit is shut down after the batch is finished and its workers are assigned to other tasks.

31 Oct Curfew imposed in Bhopal after inter-communal riots sparked by news Sikh guards had assassinated PM Indira Gandhi. Plant activities curtailed for several weeks because ability of second and third shifts to leave or arrive at work are affected.

Nov MIC drawn down in small batches.

last week of Nov. According to later testimony of plant workers, the position of second-shift maintenance supervisor was eliminated.

2 Dec Condition of plant safety systems at start of second shift:

Safety System	Condition on 2 Dec 1984
vent gas scrubber (uses caustic soda to neutralize toxic gas exhaust from MIC plant and storage tanks before release thru vent stack or flare)	on standby since MIC not in active production but available for activation
flare (burns toxic gasses to neutralize them)	insufficient capacity to for large volumes; shut down for replacement of a corroded pipe
refrigeration system (keep MIC at temperatures of 0-5 degrees C (32 to 42 degrees F) where it is less reactive)	shut down June 1984 and coolant (Freon) drained for use elsewhere in plant
firewater spray pipes (to control escaping gasses, cool over-heated equipment or douse fires)	functional but insufficient height to reach top of vent stack
safety valve between MIC storage tanks and MIC holding tank in SEVIN production area	operational; designed to hold MIC in at normal pressures and release it if pressure too high.

There are 2 competing versions of events on December 2nd between 9 and 11 pm. The first is preferred by most authors who have studied the events; the second is offered by only a few. *See note at end of this chronology for more information about the controversy.

Divergent accounts of how water entered Tank E610:

Version 1: water-washing of pipes	Version 2: sabotage
8-9 pm Second-shift production superintendent orders MIC plant	

supervisor to flush several pipes running from the phosgene system to the scrubber via the MIC storage tanks. MIC unit workers are in charge of the flushing, but maintenance department is responsible for inserting the slip bind (a solid disk) into pipe above the water washing inlet as plant manual requires. These take 30 minutes-2 hours to install. The MIC unit workers were apparently not aware that installation is a required safety procedure, and slip bind is not installed first. Temperature of MIC in tanks is between 15 and 20 degrees C.	
9.30 Water washing begins. One bleeder valve (overflow device) downstream from the flushing was blocked so water did not come out as it was supposed to. It accumulated in the pipes. A worker shut off the water flow but the plant supervisor ordered that the washing resume. By then water had risen past a leaking isolation valve in the lines being washed and got into the relief valve pipe 20 feet above ground.	Water washing proceeded as described but none of the water used for washing traveled far enough down the right pipe to enter Tank E610.
by 10.30 pm Water has flowed from the relief valve pipe through the jumper pipe into the process pipe through valves normally kept open. Water gets through an open blow-down valve that is part of the nitrogen pressurization system. It is unclear whether the valve had been left open or had failed to fully seal when last closed. Water then flows into tank E610 via a normally-open isolation valve.	
10.30-10.45 pm Second shift goes off work; third shift comes on. Washing continues after second shift worker briefs third shift worker on progress of the job.	around 10.30 pm A disgruntled worker removes a pressure gauge on a pipe leading to Tank E610 and connects a water hose to the coupler. Water enters Tank E610

Shared account of responses to detection of problems:

11 pm Third shift control room operator notices pressure gauge connected to Tank E610 has risen from a reading of about about 2 psi at the start of the shift to 10 psi. This is within the normal 2-25 psi range, so arouses no concern. Control room lacks any reliable way of monitoring tank temperatutre.

about 11.30 pm Workers in area notice MIC smell, see MIC leak near the scrubber. Find MIC and dirty water coming out a branch of the relief valve pipe on the downstream side of the safety valve, away from the tank area. They set up a water spray to neutralize the leaking MIC and inform control room personnel of situation and their actions. They then take their regular tea break, contining to discuss the situation and what they should do next.

3 Dec about 12.15 am Control room operator notices that control room pressure indicator for Tank E610 reads 25-30 psi

about 12.30 am .Control room operator notices that needle on pressure indicator for Tank E610 is pinned to the maximum reading of 55 psi. Control room operator goes out to tank area to check gauges on tank. While in tank area he hears a safety valve pop, hears rumbling in tank, and feels heat emanating from it. Returns to control room to engage the scrubber. Caustic soda does not flow as it should. A cloud of gas escapes from the scrubber stack.

by 12.40 am Plant supervisor suspends operation of the MIC plant, turns on the toxic gas sirens audible to plant and to nearby communities. Outside sirens are turned off after a few minutes. Operators turn on the fire water sprayers but water cannot reach the gas cloud forming at the top of the scrubber stack. Efforts to cool Tank E610 with the refrigeration system fail because the Freon had been drained. Gas escapes for about 2 hours.

before 1 am Plant supervisor realizes that tank E619, the designated spare, is not empty, so workers cannot relieve the pressure in E610 by transferring any MIC to E619.

by 1 am gas smell obvious outside the plant; nearby residents awake or awakened by noise and perceiving gas odor start fleeing in panic.

1.30 am Bhopal police chief informed of leak and panic by an on-duty officer who ran to his house; no significant police mobilization follows.

about 2.30 am Neighborhood siren turned on again

about 3 am Army engineer units with trucks mobilized after retired brigadier general requests help evacuating his factory near the UCIL plant (but not under the strongest gas concentrations). Army unit then expands operations to assist general populace by transporting injured to hospitals and clinics. Some mobilization of city ambulances. Medical personnel hearing of situation head to hospitals and clinics.

before 8 am Madhya Pradesh governor orders closure of plant plus arrest of plant manager and 4 other employees.

afternoon Head of India Pollution Control Board informed of accident. Efforts to learn details from Madhya Pradesh Pollution Control Board fail because phone calls cannot get through. Phone conversation with UCIL office in New Delhi (also unable to get phone calls through to the plant) provides some information about possible causes.

late afternoon Indian Central Bureau of Investigation takes control of plant and UCIL records there. CBI agents begins interviewing plant supervisors and workers; bar entry by anyone else, including other UCIL employees.

Dec Many government offices and businesses in Bhopal closed; dead buried or cremated in accordance with their families' religious traditions; initial treatment of injured proceeds

18-19 Dec Remaining MIC in storage at UCIL is plant neutralized by combining with alpha-napthol to make finished pesticides. Local population leaves town as a precaution.

1985

July Madhya Pradesh government rejects UCIL application for renewal of operating license.

Plant closed

1985-98 Some work on cleanup of plant site by UCIL.

1994 UCC sells its share of UCIL to McLeod Russell (India) Limited. McLeod Russell renames UCIL Eveready Industries India, Ltd.

1998 State of Madhya Pradesh takes over plant site from Eveready Industries.

**Note on the two versions of how water reached storage tank 610.*

Timelines of the alternate possibilities are constructed from the works of several Indian authors who collectively used interviews with plant staff, court depositions by plant staff, interviews with local residents and officials, UCIL executives and UCC technicians, and UCIL or UCC documents obtained during the post-disaster litigation. Most of the detail comes from Paul Srivastava, *Bhopal: Anatomy of a Crisis* (Cambridge, MA: Ballinger, 1987),and Sanjoy Hazarika, *Bhopal: The Lessons of a Tragedy* (New Delhi: Penguin Books India Pvt Ltd, 1987). Authors who were careful to acknowledge areas of uncertainty and disputed claims were preferred over others. Version 1, favored by local and international trade union representatives, local activists, the Indian government, transnational environmental and consumer organizations, and most technical experts (see *Chemical and Engineering News* 4 July 1988) is based on known water-washing activities. Proponents of version 2, favored by UCC after its investigators were able to visit the plant in early 1985, point out that the water washing occurred a good distance away from the storage tanks and there is no evidence water ran through the connections from the washing area to the storage tanks. They also point to evidence that the pressure gauge on the pipe leading into Tank 610 was noticed to be missing when tank

area was surveyed before 10 am on Dec 3rd and a replacement gauge was installed. (The most thorough summary of this version is Themistocles D'Silva, *The Black Box of Bhopal* 1993 who does state clearly that he was a UCIL employee – though not at the Bhopal plant – in the 1980s.) Even if sabotage were involved, no commentator thinks the saboteur was trying to cause a catastrophic gas leak; knowledge of safety hazards among the workers was spotty enough that rather few understood the full effect of introducing water into the MIC storage tanks.

The controversy was sharpened in the course of the extremely acrimonious litigation between the Government of India and UCC. UCC first raised the sabotage allegation in 1985 and repeated it in 1988 but never named the suspected saboteur. A worker believing he is the suspect publicly challenged UCC to name the suspect and denied that he had any involvement in sabotage. UCC planned to wait until the trial before the Indian Supreme Court to do so; out-of-court settlement made that unnecessary and it never publicly revealed the full basis of its suspicions. In a FAQ section of its website on Bhopal (www.bhopal.com) Union Carbide's answer to the question of if there was sabotage why hasn't the company named anyone, it says that the name is known to Indian enforcement authorities. While a useful way to avoid libel suits, the response is taken by those rejecting the sabotage theory as weakening UCC's argument.

Notice that the contending versions of events between 9 and 11 pm on December 2nd only provide different explanations of how water got into MIC storage tank 610. Everyone who has studied the disaster agrees that the injuries resulted from an unneutralized cloud of leaked gas that escaped through the vent, and that the reaction producing this cloud was triggered by water contamination. Though the concrete shielding of the storage tanks cracked above Tank 610 (indicating that its temperature got above 400 degrees F), the tank itself was found to be uncracked when inspected after remaining contents were neutralized and removed in mid-December 1984.

There is no substantial disagreement about the conditions of the safety systems that night or on the responses of the supervisors and workers after the initial MIC leak was noticed. Nor is there any significant disagreement about the inadequacy of contingency plans for in-plant response and evacuation of neighboring settlements, the poor communication about hazards with city and state authorities, or the insufficiency of warnings to surrounding settlements when the gas cloud formed. Descriptions of the extent and timing of action by city officials, state officials, army units in Bhopal, and national government officials also vary very little; controversy about government response is focused on the adequacy of actions in the days, months, and years following the disaster.

Ensuing Litigation Chronology

Key
blue = US Court Case

green = Indian Court Case

1985

March UCC and Government of India investigatory teams conclude independently that runaway chemical reaction causing MIC gas cloud was caused by water getting into Tank 610

March Indian Parliament adopts Bhopal Disaster Relief Act making Indian government the sole legal representative for all victims of the Bhopal disaster.

US Federal District Court consolidates all lawsuits pending in US about Bhopal gas leak into one case, Union of India v. Union Carbide Corporation.

Rest of year Victims and victim advocates complain about lack of effective relief all year.

Rest of year UCC stock declines; total stock value of company in December put at approximately $3 billion. UCC sells off assets (mainly petrochemicals and consumer product divisions) for $3.5 billion and borrows $2.8 billion to fend off $5.1 million takeover bid by GAF (General Analine and Film, another specialty chemical maker)

1986 Government of India lawyers and UCC lawyers begin discussion of an out-of-court settlement. Union Carbide proposes a settlement amount of $350 million under arrangements that it estimates will generate a fund for Bhopal victims of between $500-600 million over 20 years. Government rejects this offer as insufficient. Indian and foreign activist groups supporting victims have already publicized their own estimates contending that damages are at least $3 billion if loss of animals, loss of income from inability to work, loss of business in the weeks after the gas release, and related damages are also taken into account.

Apr Based on results of its September 1985 inspection of UCC's West Virginia chemical plant, the US Occupational Safety and Health Administration (OSHA) proposes fining UCC $1.4 million for violations of workplace safety and health regulations. OSHA charged UCC with 221 violations of 55 laws, listing 72 of the violations as "serious" (the classification for conditions creating substantial probability of death or serious injury).

May US Federal District Court rules on a preliminary motion in Government of India v. Union Carbide Corporation; invoking *forum non conveniens* doctrine it determines that trials relating to injuries suffered in the Bhopal disaster should be held in India.

Sept Government of India proceeds against UCC in District Court in Bhopal, seeking $3 billion in total compensation for 630,000 persons in Bhopal area.

Dec Bhopal District court orders UCC to hold $3 billion in unencumbered assets as collateral while lawsuit pending. This to prevent conscious a run-down of assets, rumors of which were rife in USA and India at the time.

UCC offers $50 million, then $80 million in compensation, amounts derived from typical Indian settlements. Amounts widely criticized, viewed as insulting by victim groups, rejected by Government of India.

1987

Jan US Court of Appeals upholds US District Court ruling that Bhopal disaster litigation should proceed in India rather than the USA.

Rest of year UCC sells off last petrochemicals and consumer products divisions

1988 Victim lawsuits continue in Indian courts. State of Madhya Pradesh also files criminal charges against Warren Anderson, then CEO of UCC, and several UCIL executives or plant supervisors for their roles in causing the disaster.

1989

Feb Under prodding by Indian Supreme Court, UCC and Government of India agree to a $470 million settlement of all Bhopal gas leak-related claims. Supreme Court endorses settlement, making it binding on both parties. It also grants immunity against criminal charges arising from the gas leak.

The $470 million is paid to the Government of India as sole legal representative of the victims.

36 special courts established in Bhopal to deal with applications for compensation

Value of UCC stock rebounds somewhat with news of settlement.

UCC CEO Robert Kennedy (replaced Anderson in 1987) completes reorganization of UCC into a holding company with 3 main divisions: chemicals and plastics, industrial products, carbon products.

1990

Oct 2 groups of victims file class action suits in Texas alleging that India failed to represent them adequately because of government agencies' ownership of UCIL stock, and therefore did not secure them sufficient compensation. Consistent with norms of mutual respect for court decisions, US courts refuse to review the Indian Supreme Court's ruling.

Nov Government of Madhya Pradesh submits final list of names of victims to be compensated for injuries suffered in gas leak to Indian Supreme Court. Total deaths attributable to gas exposure put at 3,828.

1991

Oct Indian Supreme Court confirms compensation settlement, issues ruling modifying certain parts of 1989 judgment. These include UCC establishment of a trust fund to support a new hospital in Bhopal to treat victims' ongoing health problems and revoking immunities from criminal charges.

District Sessions Court in Bhopal reinstates charges of "culpable manslaughter not amounting to murder" and lesser charges relating to voluntary infliction of harm against Warren Anderson and 8 UCIL executives or supervisors.

1992

Apr UCC establishes the Trust Fund

1993

Mar *NY Times* reports that India has paid 700 Bhopal claims; government attributes delay to complexities of verifying the claims given chaotic record keeping at the time. Victim advocates blame on government incompetence.

Oct US Supreme Court declines to review federal court decisions in 1990 cases dismissing suits against India.

1994

Apr Indian Supreme Court approves UCC plans to sell its 50.9% share of UCIL; proceeds to be given to Trust Fund for hospital in Bhopal.

Nov UCC completes sale of UCIL to McLeod Russell (India) Ltd. of Calcutta for approximately $93 million

Dec UCC provides initial payment of proceeds into Trust Fund.

Ten-Year Impact of Bhopal Disaster on UCC

	year ending 31 Dec. 1984	year ending 31 Dec. 1994
total assets	$10,518 million	$5028 million
capital	$7962 million	$2479 million
net sales	$9608 million	$4653 million
net income	$323 million	$379 million
R&D spending	$265 million	$136 million
employees	98,666	12,004

[from UCC annual reports]

1999

Jan UCC completed payments to Trust Fund, which now totals $100 million. Construction of hospital is complete and physicians and other staff being recruited.

2000

Mar Class action suit, Bano v. Union Carbide Corporation, filed in US Federal Courts by Haseena Bi and other organizations representing residents of Bhopal seeking compensation for gas-

leak related injuries and for further harm from exposure to contaminants afterward under US Alien Tort Claims Act.

Aug US District Court dismisses Bano case

2001 Trust Fund-financed Bhopal Memorial Hospital and Research Centre begins treating patients.

2004

July Indian Supreme Court orders government to release all additional settlement funds to the victims. Indian newspapers reports after all claims were paid there was still about $327 million in the fund because of interest earned while the money was in escrow pending distribution.

Nov Indian nationals file Janki Bai Sahu et al. v Union Carbide Corporation in US Federal District Court. Suit seeks compensation for personal injuries claimed to be result of exposure to contaminated water and remediation work at former UCIL plant after the gas leak.

2005

Apr Indian Supreme Court grants Indian Government Welfare Commission for Bhopal Gas Victims request for an extension of deadline on distribution of remaining funds and extends it to April 30, 2006. Indian newspapers report that approximately $390 million remains in the fund.

Dec US Federal District Court dismisses two of the three compensation claims raised in the Janki Bai Sahu case.

2006

Sept Indian newspapers report that the Welfare Commission for Bhopal Gas Victims has completed paying out all claims to listed victims of initial gas leak.

Nov The Second Circuit Court of Appeals in New York upholds the dismissal of claims in Bano vs. Union Carbide Corporation.

US Federal District Court dismisses remaining claim in Janki Bai Sahu case.

2007

Mar A group of Indian citizens files a new class action suit, Jagarnath Sahu et al. v. Union Carbide Corporation and Warren Anderson, in US Federal Courts. Suit seeks compensation for damage to six individual properties allegedly polluted by contaminants from the Bhopal plant, as well as the remediation of property in 16 colonies [squatter settlements] adjoining the plant. District Court issues a stay [suspension] of proceedings pending resolution of appeal in Janki Bai Sahu case as the issues in litigation are so similar.

-- end --

Bhopal Plant Disaster
Appendix B: Stakeholders and Level of Responsibility

by MJ Peterson
Revised March 6, 2008

Appendix Contents:

References used in this section:

Paul Shrivastava, *Managing Industrial Crises* (pp. 98-99)

T.R. Chouhan, "The unfolding of the Bhopal disaster," *Journal of Loss Prevention in the Process Industries* 18/4-6, pp 205-208 (July-Nov. 2005)

Additional readings:

L. Everest, *Behind the Poison Cloud: Union Carbide's Bhopal Massacre.* Chicago: Banner, 1985. [As title indicates, an early entry into the strongly anti-Union Carbide literature.]

Sanjoy Hazarika, *Bhopal: The Lessons of a Tragedy* (New Delhi: Penguin Books India Pvt Ltd, 1987) [summary of events leading to incident, incident, and events after by an Indian journalist who covered the disaster for the New York Times.]

International Confederation of Free Trade Unions, *The Trade Union Report on Bhopal.* Geneva: International Confederation of Free Trade Unions, 1985. [Transnational union organization report

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by a team sent to Bhopal at request of local trade unions. Critical of management practices and economizing measures in the plant, and of what it regards as management efforts to shift blame to workers.]

Ashok S. Kalelkar, *Investigation of Large-Magnitude Incidents: Bhopal as a Case Study* Cambridge, MA: Arthur D. Little, Inc, 1988. [UCC-commissioned analysis of the incident.]

W. Morehouse and A. Subramaniam, *The Bhopal Tragedy.* New York: Council on Public and International Affairs, 1988. [Account with considerable attention to the confusions and delays in medical care and relief combined with advocacy of broad victim claims; an early rendition of the calculations claiming all damages amount to losses of $3 billion.]

Paul Shrivastava, *Bhopal: Anatomy of a Crisis* (Cambridge, MA: Ballinger, 1987).

Paul Shrivastava, "Rereading *Bhopal: Anatomy of a Crisis* through a feminist lens," *Journal of Management Inquiry* 3/3: 278-285 (Sept. 1994). [Shrivastava adopts Carol Gilligan's "In a different voice" argument about fundamental differences in ways of thinking particular to males and females plus some of the ecofeminist literature to conclude that male modes of thinking make industrial accidents more likely because of their effects on management style.]

<u>For technical details see:</u>

R Dagani, "Data on MIC's Toxicity are Scares, Leaving Much to be Learned." in *Bhopal: A C&EN Special Issue. Chemical Engineering News*. 11 February 1985, pp. 37-47.

Frank P. Lees, "Bhopal' in *Loss Prevention in the Process Industries: Hazard Identification,* 2nd Ed. Oxford, UK: Butterworth-Heinemann, 1993. [a later summary.]

W. Worhty, "Methyl Isocyanite: The Chemistry of a Hazard" in *Bhopal: AC&EN Special Issue. Chemical Engineering News.* 11 February 1985, pp. 27-37.

H-O-T Analysis of Industrial Accidents Applied to Bhopal Gas Leak

From Paul Shrivastava, *Managing Industrial Crises* pp. 98-99

Human Factors (operators – production personnel and plant managers)

Organizational Factors (operating policies and procedures of plant, place of producing unit in its larger organization; place of that larger organization in relation to competitors, suppliers, clients, regulators)

UCIL production policies and procedures weak; adapted from UCC but with local differences

Bhopal plant, low profit plant of an unimportant division (pesticides) for UCC and for UCIL

Plant established at a time its economic viability uncertain, also under 8 managers in 15 years

Technological Factors (production system design)

General conditions increasing probability of serious incident

Process design allowed for large tank storage of MIC; other process designs use smaller storage tanks or a flow process that uses MIC immediately after it is made

Manual, noncomputerized, sometimes nonredundant, control/monitoring systems

Immediate enablers of massive gas leak on 3 Dec. 1984

Lack of positive nitrogen pressure, allowing contaminants in through the nitrogen line

Water entered tank through relief valve and process pipes

Water by-passed either the blow-down valve or the safety valve

Both flare tower and gas scrubber off-line

No empty tank for operators to shunt MIC into when they realize there is problem

Tank over-full (75-80% of capacity when manual says 50% max)

No investigation of what kept water from flowing out drain valve when water flushing was begun on 2 Dec.

Stakeholder Orientations In Industrial Disasters

generalized from Bhopal example given in Paul Shrivastava, *Managing Industrial Crises* pp. 98-99

Stakeholder Type	Specific Stake-Holder	Stakeholder Structure	Stakeholder Frame of Reference	Antecedent Conditions	Crisis Context	Triggering Event	Crisis Processes
Government		Hierarchical agencies under political control	Publicly articulated Usually assumes objective knowledge of physical and social factors; Means-ends rationality emphasized; following procedure important Political, social, relief;	Rate of economic development in area Growth of area population; Perceived need for jobs, tax revenues	Administrative capacity Relation with company	Industrial accident; Desire to hold company liable for damages so to secure financial compensation for relief costs	Damage mitigation (e.g., evacuation); Immediate aid to victims
Business Firm		For-profit corporation: hierarchical within; Arms length transactions outside	Articulated within firm; not well articulated outside Assumes objective, technical knowledge; Means-ends rationality very important. Applies scientific or economic models to activity	Degree of government regulation; Content of government regulation; Current market conditions	Competitive pressures; Company plans; Size and socioeconomic character of population living in neighborhood of plant	Sequence of events in plant that yield accident	Damage control First aid to employees
Victim		Individuals, households, advocates	Little or inchoate articulation of standpoint Evens filtered through subjective responses Social; Multiple, intuitive; Experiential; Medical, economic; Low articulation	Stability of neighborhood; Recency of settlement in area; Degree of familiarity with industry and general industrial hazards	Level of specific hazard awareness; Level of group mobilization	Effects of accident: In-plant Outside plant	Self-protection if warned; Government ordered evacuation; Uncoordinated fleeing

Stakeholder Effects and Responses

From Paul Shrivastava, *Managing Industrial Crises* pp. 98-99

Stakeholder Type	Specific Stakeholder	Crisis Effects	Crisis Responses
Government		Deaths, injuries, uncertain effects; Changes in key personnel blames for poor response	Political control of crisis, including assignment of blame Medical assistance and longer-term rehabilitation if needed Management of victim compensation process Regulatory changes
Corporation		Deaths, injuries in firm Deaths, injuries outside firm Physical damage Lawsuits if damage extensive Financial and market losses Negative reputation if crisis severe	Public information/relations efforts Legal defense Absorption of financial losses
Victim		Deaths, injuries Long effects on self-household if death or severe injury Economic losses	Sue identifiable likely causers; Seek government assistance; If large numbers, add self-organization and public Protest if needs unmet

Comparison of Features of MIC plants in Institute, West Virginia, USA and Bhopal, Madhya Pradesh, India

From T.R. Chouhan Ex-MIC Plant Operator, Union Carbide Plant, Bhopal
Table 1 in "The unfolding of the Bhopal disaster," *Journal of Loss Prevention in the Process Industries* 18/4-6, pp 205-208 (July-Nov. 2005) Available online 8 Sept. 2005

Additions/Revisions by MJ Peterson [in brackets] 2008

WEST VIRGINIA PLANT	BHOPAL PLANT
Lines and instruments spread out over whole tank	All on one single manhole
Computerized control	No computerized control [manual only]
PVH and RVVH lines: 304 SS	C-Steel (although prohibited due to safety considerations)
Unit storage tank between MIC manufacture and large storage tank to check purity	No such tank
Four Vent Gas Scrubbers (VGS) so inbuilt redundancy	One vent gas scrubber – so no redundancy
VGS had no atmospheric vent	VGS [had atmospheric vent so] released gases into air
Two flare towers (FT) so inbuilt redundancy	One flare tower – so no redundancy
FT designed for emergency MIC release	FT designed for occasional releases only
VGS, FT operational around the clock due to redundancy	Not available when shutdown for repairs
Intermediate, non-interactive refrigerant	Direct brine as coolant: could react with MIC in case of leak
α-Naphthol added through pipe line	α-Naphthol added manually from jute sacks after opening MIC reactor manhole. Several other hazardous operations performed manually
Pressure, temperature, level instruments functioned well	Not trustworthy; temperature indicator worked only the first few months
PVH and RVVH lines from storage tank direct to VGS and flare tower	Lines from other equipment also joined these lines. Probability of contamination of MIC high
MIC storage temperature ≤5°C [42°F]	<5°C when drums being filled to minimise vapor loss. Refrigeration shutdown since May 1984. Power saved (≈$ 20/day)>cost of MIC vapor loss
Operation and maintenance under trained and experienced staff, enough in number	Not so; Training and number of staff both declined
Complete evacuation plan for community in place	No evacuation plan for community
Hospital, train, road, river transport, police, civic administration informed in an emergency	No such arrangements existed

Exercise: Identifying Responsibilities

DIRECTIONS

Inquiries pursued after the toxic gas release from the Bhopal chemical plant on 2-3 December 1984 identified multiple factors as contributors to the disaster. Inquiries also identified the following actors as relevant to conditions in the plant at the time of the disaster:

Top management of Union Carbide Corporation (UC) – US-based parent company.

Top management of Union Carbide (India) Limited (UCIL) – Indian company owned 50.9% by Union Carbide Corporation and 49.1% by various Indian nationals.

UC's US-based plant designers

UC's US-based plant operations engineers sent to survey Bhopal plant.

UCIL's in-house and hired plant building team.

UCIL's engineers sent to survey Bhopal plant

UCIL's Bhopal plant manager

UCIL's plant operators (supervisors, operating teams, maintenance teams)

Government of India, Government of State of Madhya Pradesh, Government of City of Bhopal

Consider each factor in the table on the next page. Then identify the actor or actors who had immediate responsibility for the problem because they were in a position to know about and take action to correct the problem as it happened (mark their box IR). Identify the actor or actors who had supervisory responsibility because they received regular reports about plant operations, production, and conditions and controlled resources (personnel, money, equipment) beyond what was normally available to the operators and could shut down operations if need be (mark their box SR). Identify the actors who had regulatory responsibility because they established, monitored compliance with, and could order those more directly concerned to stop violating safety rules (mark their box RR).

Identifying Responsibilities

Condition	Actor	UC top management	UCIL top management	UC plant designers	UC engineers	UCIL plant builders	UCIL engineers	UCIL plant manager	UCIL plant workers	Governments in India
Design	No computerized early warning system and data logger									
	Process involves long-term storage of large amounts of MIC in tanks									
	Flare tower is 33 m high and water sprays reach 12/15m									
	Scrubber maximum pressure is 15 psi & rupture disk is set to let gasses escape tanks when pressure reaches 40 psi									
	Single-stage manual safety system rather than four-stage electronically-controlled system common in similar plants									
	No backup system to divert escaping gas into an effluent area for quick neutralization as used in other firms' MIC plants									
	Included manual system for engaging scrubber less reliable than automatic systems available									
	Refrigeration unit too small to cope with a runaway reaction									
	Addition of jumper pipe connecting relief-valve vent header and process-vent header									
Equipment	Rusted or leaking valves and pipes									
	Unreliable instruments and gauges									
	Refrigeration unit erratic									
	Safety and operating manuals in English, so not easily read by all operators and maintainers									
Operating Conditions	Low plant staff awareness of hazards of MIC and phosgene gasses									
	Reduction in number of plant operators									
	Uneven training in and following of safety measures by plant operators									
	Chloroform contamination of MIC in Tank E610 higher than allowed									
Operating Procedures	Repeated ignoring of inability to pressurize Tank E610 with nitrogen									
	Refrigeration unit shit off several months before									
	Flare tower and scrubber were both nonoperational when large amounts of MIC are stored									
	Spare tank not empty at time of incident									
	Tank E610 was 75-80% full on 2 Dec. though recommended maximum level was 50%									
	Water flushing of pipes was resumed on 2 Dec. without investigating and correcting whatever kept water from coming out the other end									

International Dimensions of Ethics Education in Science and Engineering
Case Study Series

Bhopal Plant Disaster
Appendix C: Economic / Industrial Climate of India

by MJ Peterson
Revised March 3, 2008

Appendix Contents:

References used in this section:

Paul Shrivastava, *Bhopal: Anatomy of a Crisis* (Cambridge, MA: Ballinger 1987)

Dilip K. Sheth, *Treatise on FERA (Law and Practice)* vol. 1 New Delhi: Bharat Law House Pvt Ltd, 1991. [Legal textbook and reference for practicing lawyers]

R.N. Mukherjea, R.N. Bagchi, and S.C. Banerjee, "Safety in Indian chemical process industries: A case study," pp. 919-937 in *Report of the 9th International Symposium on the Prevention of Occupational Accidents and Diseases in the Chemical Industry. Lucerne, Switzerland 5-7 June 1984.* Heidelberg: Berufsgenossenschaft der chemischen Industrie, 1984. [Assessment of conditions in the various types of firms comprising the Indian chemical industry by Indian specialists published a few months before the Bhopal gas leak.]

Sanjoy Hazarika, *Bhopal: The Lessons of a Tragedy* (New Delhi: Penguin Books India Pvt Ltd, 1987)

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India's Approach to Economic Development

M.J. Peterson, 2008

The Indian government's approach to economic development from independence in 1948 through the 1980s was shaped powerfully by the experience of colonial rule and the economic beliefs of its post-independence leaders. Both contributed to the creating of a highly regulated mixed economy, popularly referred to even at the time as the "license Raj" because of the pervasiveness of requirements to secure permits for various forms of economic activity.

The British East India Company was the largest economic enterprise operating in India between actor in India between 1750 and 1850, and also the de facto ruler of an increasingly large part of the country between 1770 and 1833. The British government brought its political activities under parliamentary supervision in 1833, replaced it with a crown colony administration in 1858, and reduced its economic significance by opening the India trade to other firms in 18--. In the 18th century, the Company's trading activities focused on purchasing India-made textiles, dyes, and spices for export to England (India did not become a major tea producer until the 1880s). As textile production in England increased with introduction of industrial methods after 1780, the British Parliament did what all mercantilists of the time did: it adopted laws closing the British home market to Indian textiles and ensured the opening of colonial markets to British goods. The East India Company then shifted its main activities to selling British-made manufactured goods in India and buying Indian raw materials for sale in the British home market and elsewhere. Even after the East India Company's monopoly was abolished, British tariffs remained high until adoption of Free Trade legislation lowering tariffs in 1846. At that point, however, Indian firms did not regain British customers because British firms were far enough ahead in the mechanization of production to out-compete Indian firms despite lower Indian wages. The British kept India's tariffs low, allowing British manufacturers to dominate even Indian domestic markets for textiles, shipbuilding, metalworking, glass-making, and paper-making. The "British Raj" did supply infrastructure in the form of ports, railways, and better roads in major towns, but these were designed to facilitate administration, the export of Indian raw materials and the distribution of imported manufactured goods around the country rather than the activities of Indian manufacturing.

At independence all educated Indians agreed that India's current lack of industrialization and economic development more generally was the result of these colonial-era policies. The new central government could expect widespread support for any policy that appeared to set the country on the path to industrialization. At the same time, the partition of British India into India and Pakistan (today's Bangladesh was originally the eastern part of Pakistan) further disrupted economic patterns by separating some local processing plants from their sources of materials. In all, the new Indian political elite had a daunting task ahead.

The new political elite brought to this task a set of social democratic beliefs very similar to those guiding the British Labour Party, which was in power in the UK from 1945 until 1951 and returned to power periodically in later years. In the view of both the Labour Party and the Indian political elite, private enterprise was too focused on profitability of the firm to be left to operate on its own. Political leadership with a broader view of the social good was needed to establish an effective welfare state providing more equal opportunity and greater distribution of social services (both countries), transform an economy from agricultural to industrial (India), or address the effects of years of declining economic competitiveness (Britain). Neither sought to abolish private enterprise and institute Soviet-style central planning, but both believed that only a mixed economy, with major sectors of the economy reserved to state-owned enterprises operating as instructed, and powerful state agencies able to set traditional social interests aside and provide the services of a

welfare state while collecting the tax revenues needed to maintain it would successfully meet the economic challenges facing the country.

The new Indian leadership immediately began using its powers to reverse the long dependence on outside industry and capital. Provisions of the 1950 Constitution strengthening the powers of the Union (central) government vis-à-vis the States included the stipulation that "the regulation of foreign and interstate commerce falls within the exclusive domain of the Parliament." The further stipulation that "The executive power of the Union Government extends over matters that are within the competence of the Parliament of India and the executive power of the states" meant that administrative regulations issued by the central government decisions could override contrary state government regulations.

The Indian government's policies on dealings with foreign companies and investors were made clear in its 1948 Resolution on Industrial Policy:

> … while it should be recognized that participation of foreign capital and enterprise, particularly as regards industrial technique and knowledge, will be of value to the rapid industrialization of the country, it is necessary that the conditions under which they may participate in Indian industry should be carefully regulated in the national interest. Suitable legislation will be introduced for this purpose. Such legislation will provide for the scrutiny and approval of the Central Government of every individual case of participation of foreign capital and management in industry. Such legislation will provide that, as a rule, the major interest in ownership and effective control should always be in Indian hands; but power will be taken to deal with exceptional cases in a manner calculated to serve national interest. In all cases, however, the training of suitable Indian personnel for the purpose of eventually replacing foreign experts will be insisted upon. … Import of technology is at the core of collaborations. … Where technology is available in India, it must be preferred to foreign technology. Where it is not available, it should be imported at the lowest cost. All technology, once imported into India, is Indian technology. It should not be paid for beyond a period of five years and its use must be preferred to import of similar technology.

The Indian Government proceeded to establish state-owned enterprises in the major sectors of the economy, with steel, railways, shipping, aviation, and electrical power generation most prominent among them. The Industrial Policy Resolution of 1956 outlined a division of the Indian economy into three sectors: industries reserved exclusively to state-owed enterprises, industries in private ownership but under the initiative of the state to nationalized later, and industries left in the hands of privately-owned firms. The government had already begun extending its control over private business, including a number of large Indian conglomerates that became multinational firms in their own right during the 1960s by establishing subsidiaries in other developing countries, through the Industries Development and Regulation Act of 1951. All private businesses (or at least all of the large enough to be noticed; India quickly developed a large "underground" economy of tiny enterprises that did not bother with licenses) needed a government license to make significant changes in their activities. Licensing requirements covered establishing a new factory or plant, using an existing factory or plant to make additional products, substantially increaseing production capacity in any factory or plant, taking over the existing business of a firm previously exempt from licensing requirements, and changing the location of an existing factory or plant.

The rules did not cut off all foreign private investment. Some foreign-owned firms had been doing business in India before independence; others, attracted by the large potential market suggested by India's population and relative wealth, decided they could live with the regulations. The rules did mean, however, that the government could exercise a great deal of influence over the sorts of foreign investments made

and the activities of foreign investors. Successive Indian governments used these powers to channel foreign investment into areas where foreign technology was more advanced than local technology, and away from trade and finance. Government guidance of foreign investors was reinforced through provisions of the Foreign Exchange Regulation Act, which imposed controls on cross-border currency movements. These controls permitted the government to guide the amounts and types of investments as well as control the rate at which dividends on those investments were taken out of the country.

Chemical Industries in India, summer 1984

from R.N. Mukherjea (Chemical Engineering Department Jadavpur University), R.N. Bagchi (same), and S.C. Banerjee (Directorate of Factories, West Bengal), "Safety in Indian chemical process industries: A case study," pp. 919-937 in *Report of the 9th International Symposium on the Prevention of Occupational Accidents and Diseases in the Chemical Industry. Lucerne, Switzerland 5-7 June 1984.* Heidelberg: Berufsgenossenschaft der chemischen Industrie, 1984

1.0 Introduction

The chemical process industry in India has shown remarkable growth during the last three decades. With about 18% annual growth rate the chemical industry's turnover increased from only Rs. 1200 million in 1956 to more than Rs. 30,000 million in 1976. Its contribution to the Gross National Product is more than Rs. 15,000 million. It occupies forth place after engineering, textiles, and mining industries in terms of investment and turnover. The projected investment in the eighties is of the order of Rs. 10,000 crores (US $10 billion). The direct employment in the chemical industry is more than 2 million people.

The expansion of the chemical industry has been not only quantitative, but there has been also rapid qualitative growth in the industry, which is now producing an increasing range of new chemicals, which still have recently been imported. The capabilities in design and plant engineering have also made spectacular progress and it is expected that the annual turnover of chemical plant and equipment will reach Rs. 5000 million in 1990.

2.0 Safety Requirements

Increased diversification in the range of products requiring in many cases sophisticated process technology and equipment would involve increased safety hazards. This would demand a concurrent growth in safety consciousness and application of adequate safety measures. Unfortunately, however, it is found that the progress in safety technology has not been quite satisfactory due to various constraints. The problems in the area of safety and occupational health appear to be particularly complex in the small and medium scale sector, which plays an important role in the Indian chemical industry, producing a large number of small volume, high value chemicals employing sophisticated technology. Due mainly to economic and organizational factors these units often cannot afford to introduce adequate safety devices and equipment nor to employ specially trained safety personnel to plan and ensure proper safety measures. In the large scale industry, also particularly those in the private sector, sometimes the motivation and sense of responsibility to ensure safety is not adequate. This is deplorable particularly in a developing country like India where the level of education and safety consciousness of the workers at the shop level is rather poor. This would warrant that at the process design and project engineering stages efforts should be made to realize maximum safety in the plant by applying the modern techniques of safty analysis and reliability engineering. Unfortunately, however, education and training facilities in different aspects of safety engineering are not adequate.

3.0 Safety Administration

In this context the role of government agencies to ensure the safety of human lives and properties involved in potentially hazardous operations of chemical process industries becomes very important. The administration of safety and industrial health is undertaken by the Factories Inspectorate of the State Governments with close co-operation of Factories Advisory Service under the Central Government. The State Inspectorates have safety engineers and technologists as well as experts in industrial hygiene and occupational medicine. The Central Factory Act provides power to the State Governments to enact rules relating to safety, health and welfare of employees. The schedule of safety measures in relation to some

specific machineries and processes framed in the State Factories Rules are very helpful in ensuring safe working environments with provisions for health care of workers requiring special precautions. Apart from [specific] safety precautions… the Rules have specific provisions for declaring some operations as dangerous. Almost all chemical industries are included in this list and there are guidelines for safe handling and use of dangerous chemicals. Specific rules regarding storage and handling of chemicals susceptible to fire and explosion are enforced by the Directorate of Explosives, while the Boiler Inspectorate supervises installation and operation of boilers and other pressure vessels.

Accidents in the chemical industry are mainly due to poor design, fabrication, or operation of the plant along with failure in maintaining good housekeeping, improper storage of combustible substances, inadequate discharge or prevention of static charge. In case of a serious accident there is provision in our Act for involving outside experts as “competent persons” and assessors drawn from the Universities and consultancy organizations to conduct inquiries and studies in order to draw significant safety conclusions for devising better control measures.

Excerpts from and Comments on Union of India Foreign Exchange Regulation Act 1973 (Act 46 of 1973)

Gazette of India Extra, Part II, section 1, 20 Sept 1973 pp. 535-584

[This compilation of provisions relevant to industrial enterprises relies on text as given in Dilip K. Sheth, *Treatise on FERA (Law and Practice)* vol. 1 New Delhi: Bharat Law House Pvt Ltd, 1991]

Preamble

An Act to consolidate and amend the law regulating certain payments, dealings in foreign exchange and securities, transactions indirectly affecting foreign exchange and the import and export of currency and billion, for the conservation of the foreign exchange reserves of the country and the proper utilisation thereof in the interests of the economic development of the country.

Section 1. Short title, extent, application and commencement

(2) [This Act] extends to the whole of India.

(3) It applies also to all citizens of India outside India and to branches and agencies outside India of companies or bodies corporate, registered or incorporated in India.

Section 28. Restrictions on the appointment of certain persons and companies as agents or technical or management advisers in India.

(1) Without prejudice to the provisions of section 47 and notwithstanding anything contained in any other provision of this Act or the Companies Act 1956 a person resident outside India (whether a citizen of India or not) or a person who is not a citizen of India but is resident in India, or a company (other than a banking company) which is not incorporated under any law in force in India or in which the non-resident interest is more than forth percent, or any branch of such company, shall not, except with permission of the Reserve Bank,

(a) act, or accept appointment, as agent in India of any person or company, in the trading or commercial transactions of such person or company; or

(b) act, or accept appointment, as technical or management adviser in India of any person or company; or

(c) permit any trademark which he or it is entitled to use, to be used by any person or company for any direct or indirect compensation.

(2) Where any such person or company (including its branch) as is referred to in subsection (1) acts or accept appointment as such agent, or technical [or] management adviser, or permits the use of any such trademark, without the permission of the Reserve Bank, such acting appointment or permission, as the case may be, shall be void.

Explanation: For the purposes of this section,

(a) “agent” includes any person or company (including its branch) who or which buys any goods with a view to sell such goods before any processing thereof;

(b) “company” means any body corporate and includes a firm or other association of individuals;

(c) “processing” means any art or processing for producing, preparing or making an article by subjecting any material to a manual, mechanical, chemical, electrical, or any other like operation but does not include any process incidental or ancillary to the composition of a manufactured product such as the dividing, pressing, compressing, packing, repacking, labelling, relabelling, branding, or the adoption of any such treatment as is necessary to render such product marketable to the consumer.

(d) “technical or management adviser” includes any person or company (including its branch) required to tender any technical or management advice, even though the tendering of such advice is incidental to any other services required to be rendered by such person or company.

Section 29. Restrictions on establishment of places of business in India

(1) Without prejudice to the provisions of section 28 and section 47 and notwithstanding anything contained in any other provision of this Act or the provisions of the companies Act (1 of 1956), a person resident outside India (whether a citizen of India or not) r a person who is not a citizen of India but is resident in India, or a company (other than a banking company) which is not incorporated under any law in force in India or in which the non-resident interest is more than forth percent or any branch of such company shall not, except with general or special permission of the Reserve Bank:

(a) carry on in India, or establish in India a branch, office or other place of business for carrying on any activity of a trading, commercial, or industrial nature, other than an activity for which the carrying on of which permission of the Reserve Bank has been obtained under section 28; or

(b) acquire the whole or any part of any undertaking in India of any person or company carrying on any trade, commerce, industry or purchase the shares in India of any such company.

[Summary of note on related Government rules in Sheth, vol. I, p. 405-406:
Related rules issued on 20 December 1973 required that (1) Indian operations of foreign companies that are not separately incorporated in India must be organized as an Indian company, (2) no such Indian companies may be wholly foreign-owned – thee must be at least 26% Indian ownership, (3) large companies must progressively sell additional shares to indiand so that foreign ownership is no more than 40%. On 28 October 1980 the government added a rule permitting investors from oil exporting developing countries to acquire 40% of a new or existing company incorporated in India with a minimum of licensing and permit formalities.]

Section 30. Prior permission of Reserve Bank required for taking up employment, et in India by nationals of foreign states.

(1) No national of a foreign State shall, without the previous permission of the Reserve Bank,

(a) take up any employment in India, or

(b) practice any profession or carry on any occupation, trade, or business in India,

in a case where such national desired to acquire any foreign exchange (such foreign exchange being intended for remittance outside India) out of any moneys received by him in India by reason of such employment or the practicing of such profession or the carrying on of such occupation, trade, or business as the case may be.

(2) Where any national of a foreign State desires to obtain the permission of the Reserve Bank under sub-section (1), he may make an application to the Reserve Bank in such manner and containing such particulars as may be prescribed.

…

[Summary of comments in Shelth, *Treatise on FERA* vol. I, pp. 428-432:

Though the plain wording of the section suggests that foreigners who will not exchange part of their salary out of Rupees into home currency for sending out of the country are not covered, Indian courts ruled that section 30 applied even to those foreigners because of (i) the possible "indirect effects" on India's foreign exchange situation and/or (ii) because the Reserve Bank's decisions are based on "policy" it has wide discretion to decide what may indirectly affect India's foreign exchange situation. Arum Kumar v. Reserve Bank of India (1983) 54 Co. Cases 176 (Delhi).

In 1977 and 1979 the Reserve Bank adopted special regulations for Indian companies intending to employ foreign technical staff in the construction, set-up, and initial running of a new or expanded industrial plant pursuant to government license> They could get blanket approval for use of the foreigners from the Department of Industrial Development. The Indian employer (not the foreigner) had then to notify the Reserve Bank of the names and expected durations of employment of the foreigners.]

Section 31. Restriction on acquisition, holding, etc. of immovable property in India

(1) No person who is not a citizen of India and no company (other than a banking company) which is not incorporated under any law in force in India or in which the non-resident interest is more then forty percent shall, except with the previous general or special permission of the Reserve Bank, acquire or hold or transfer or dispose of by sale, mortgage, lease, gift, settlement or otherwise any immovable property situate in India
Provided that nothing in this sub-section shall apply to the acquisition or transfer of any such immovable property by way of lease for a period not exceeding five years.

Section 76. Factors to be Taken into Account by the Central Government and the Reserve Bank while giving or granting permissions or licenses under the Act.

Save as otherwise expressly provided in this Act, the Central Government or the Reserve Bank, as the case may be, shall while giving or granting any permission or licence under this Act, have regard to all or any of the following factors, namely:

(i) conservation of the foreign exchange resources of the country;
(ii) all foreign exchange accruing to the country is to be properly accounted for;
(iii) the foreign exchange resources of the country are utilized as best to subserve the common good; and
(iv) such other relevant factors as the circumstances of the case may require.

Some Criticisms of the 1973 Foreign Exchange Regulation Act

[Remarks from debates in the Lok Sabha ("House of the People") of the Indian Parliament, quoted in Dilip K. Sheth, *Treatise on FERA (Law and Practice)* vol. 1 New Delhi: Bharat Law House Pvt Ltd, 1991]

Mr. Jyotirmoy Basu

"… Any company having 15% or more equity participation should be termed as foreign controlled company. To prevent drainage of foreign exchange, financial collaboration with foreigners should be totally banned. Technical collaboration, however, in genuine priority section where technical know-how is not readily available in this country, foreign participation can be allowed for a limited period of time. There should be a rigidly applicable maximum ceiling on the quantum of royalty on technical know-how etc. Under no circumstances should it exceed a maximum of five percent of the labor cost. Use of international brand-names, capitalization of trade-marks, etc should be banned."

Mr M.R. Venkataraman

"After 25 years of independence it is pointless and harmful to allow any foreign capital whatever to operate here. It will do so only to the detriment of our economy. … This participation of foreign capital covers one of the important sources of the leakage of foreign exchange. This does not mean we cannot take loans on reasonable interest and on our terms from other countries for the needs of our economy. But where is the need to allow foreign capital to continue to exploit us, and even to recognize it by a statute?"

Government of India 4th Five-Year Plan

[Originally issued in July 1970; accessed from Government of India, National Planning Commission website (http://planningcommission.nic.in/plans/planrel/fiveyr/default.html) in January 2008]

Preface

Planning is the vital instrument we have adopted to realise the social objective enshrined in our Constitution. Though the Five Year Plans we have already achieve a significant increase in the national income in the past eighteen years and laid the foundations of technological advance. The Plan is fast modernising our agriculture and strengthening and diversifying our industry. Above all, it has reinforced national unity and purpose.

The attack on our territory in 1962 and again in 1965 forced us to modify the pattern of national expenditure. Before we could reconcile the competing claims of development and defence, drought struck us. Foreign credits became uncertain, Recession followed. All these seriously restricted our freedom of choice. We had to divert our energies to fight drought and near famine and their aftermath. For some time, long-term planning had to be virtually suspended. But we succeeded in turning adversity to good use. We concentrated on import substitution which further enlarged our industrial base. This along with the need for more foreign exchange put us on the path of a more fruitful export drive. We maintained our investment in development work, especially in intensive agricultural programmes.

A new period has how opened. There is a welcome upsurge in the economy, and the increases in agricultural production have brought us nearer to self-sufficiency in foodgrains. But, inevitably, there are other problems, and a fresh challenge to face. Rural disparities have increased, partly owing to the very efforts we have made to move rapidly towards self-sufficiency in food, and partly owing to a certain tardiness in the matter of implementing the land reforms. Although the industrial recession has waned, new industries are not coming up fast enough and unemployment, especially of technically trained persons, continues to be acute. We have a larger and, understandably enough, a more articulate population.

Planning is the method to which we are committed for meeting such challenges. We have carried out three Five Year Plans. Each Five Year Plan has addressed itself specially to problems which have emerged either because of new political and economic developments in the country and in the world, or as a consequence of progress already achieved. The priorities and the emphasis have necessarily changed and have had to be adjusted from Plan to Plan, but we have always kept in view our long-term objectives.

The Fourth Plan represents a conscious, internally consistent and carefully thought out programme for the most efficient exploitation of our resources possible in existing conditions. The basic aim is to raise the standard of living of the people, especially of the less privileged sections of society. Our planning should result not only in an integrated process of increased production, but rational distribution of the added wealth. The overriding inspiration must be a burning sense of social justice. While increased production is of the utmost importance it is equally important to remove or reduce, and prevent the concentration of wealth and economic power. The *benefits* of development should accrue in increasing measure to the common man and the weaker sections of society, so that the forces of production can be fully unleashed. A sense of involvement, of participation by the people as a whole, is vital for the success of any plan of rapid economic growth. This can only be evoked by securing social justice, by reducing disparities of income and wealth, and by redressing regional imbalances. A reorientation of our socio-economic institutions in this spirit is accordingly, a first necessity.

One year of this Plan has already gone by. Between the Draft Plan and the present document, certain important changes have been made. The projected investment in the public sector has been stepped up so

as to enable us to undertake a larger and bolder agenda of work. New schemes have been added to help the small farmer throughout the country, especially in the unirrigated areas. The emphasis is squarely on areas that have hitherto suffered from neglect. Transport and housing problems in urban regions will receive more attention. A small but significant beginning is also being made with special programmes for children.

The Fourth Plan thus provides a necessary corrective to the earlier trend which helped particularly the stronger sections in agriculture as well as in industry to enable them rapidly to enlarge and diversify the production base. In the long run, the full potential of growth cannot be realised unless the energies of all our people are put to profitable use. The emphasis on spreading the impetus and benefits of economic growth to the weaker sections is thus necessary in the interest of equality as well as growth. The Plan will now assist the less prosperous sections of our farming population to improve their position and make a yet bigger contribution to the national economy. Greater industrial activity and the modernisation of agriculture such as is proposed through the wider use of electric power and the adoption of intensive methods of cultivation in both irrigated and dry areas, would mean that a larger proportion of young people seeking jobs could find employment nearer home. At the same time, there are some new schemes, *e.g.,* for a network of service centres in the rural areas, which will open out opportunities for young entrepreneurs.

The nationalisation of the fourteen big banks is evidence of our determination to bring a greater volume of resources within the area of social decision. It has effected a major change in our economic structure. It enables us to pay more attention to the "small man's" needs, and it restricts the scope for the monopolistic operations of the privileged few. Among other areas where social considerations have still to make a comparable impact are the enforcement of land laws, the management of public sector enterprises, and the toning up of the administration as a whole.

There can be no doubt that the responsibilities devolving upon the public sector —without diminishing those of the private sector, in our mixed economy—will grow in range and volume. Socialism involves a reordering of society on a rational and equitable basis and this can only be achieved by assigning an expanding role to the public sector. Following the reorganisation of credit policies resulting from the nationalisation of major banks, the public sector can be expected more and more to occupy the commanding heights of the economy. It alone would be in a position to undertake investments of the requisite magnitude in such industries of vital importance to us as steel, machinery, machine tools, power generation, ship-building, petrochemicals, fuels and drugs. Naturally, the administration of public enterprises poses some problems of its own (here as in other countries) but they are not insuperable and will be overcome as we gain experience.

In addition to the fight against poverty and economic inequalities, the Plan seeks to enlarge the area of self-reliance in terms of financial resources and technological inputs. Here, too, the public sector has an important part to play. Besides striving to set an example in better management methods and ushering in a new pattern of worker management relations, the public sector should increasingly base itself on domestic know-how. The public and private sectors have both been too ready to look to foreign collaboration not only for financial but for technological resources. Such collaboration may be unavoidable when new processes have to be introduced but excessive reliance on it has induced a state of mind which inhibits the development of our own technological skills and managerial talents. We should rely more and more on our own machinery and technical know-how, even though it may entail some initial risks and difficulties. This does not mean that we should be indifferent to the latest developments in technology, especially in the fast-growing sectors. But it would be folly to forget that a nation's strength ultimately consists in what it can do on its own and not in what it can borrow from others.

There has been a noticeable change in recent years in the climate of international economic cooperation. It is now increasingly reaffirmed by responsible sections of public opinion in the lending as well as in the borrowing countries that development assistance should not be regarded as an instrument of foreign or commercial policy but as a means of correcting dangerous imbalances in the world economy. However, "aid" is in reality credits which have to be repaid; and even if such credits are available on terms which are concessional in some respects, they often have features which are not consistent strictly with the objective of development. For some time to come we can benefit by more external credits, especially untied credits on concessional terms. But we have to take note of international realities as they are and reduce our reliance on foreign credits.

The policy of self-reliance does not mean that we should be actually reducing imports from the rest of the world. In fact, as the pace of development quickens, imports of industrial raw materials, intermediates and special components will go up. But we propose to pay for them increasingly through our own earnings from exports. Economic independence, therefore, hinges to a considerable extent on how we fare in export markets; and our export performance in turn would depend on the state of our economy at home and our success in developing a purposive, planned approach to the problem.

The complaint that planning has led to a rise in prices and that planning is, therefore, harmful, is misconceived and unfounded. Consumers with fixed incomes, particularly in urban areas face hardship when prices rise; but at the other extreme, when prices are reduced or depressed to uneconomic level, producers suffer and employment sags. If development means larger real incomes to ever larger numbers of people, some price increases can hardly be avoided. What we must ensure, however, is stability in respect of the core items of family consumption. An adequate supply of foodgrains and articles of everyday use must be maintained at fairly stable prices. Agricultural scientists who have brought about such notable increases in yields of wheat, and to some extent of millets and rice, have now turned to the task of bringing about similar gains in pulses and cash crops like oilseeds, cotton and sugarcane. In general, the possible impact of development plans on the price situation has been carefully studied, and every effort will be made to keep production and prices in balance.

Planning certainly has its critics, but the fact remains that in modern conditions, and in a developing country like ours, economic planning has become indispensable. Compared to the tasks to be accomplished, the resources of money, trained manpower and administrative and managerial skills are in short supply, and they have to be allocated primarily with a view to the national interest rather than the interest of any private individual or group. This is, after all, what the Plan seeks to do. At the same time, and through such rational allocation, it can lead to an augmentation of the now scarce resources, and this gradually extend the limits of our economic freedom.

For us in India, planning is a charter of orderly progress. It provides a framework of time and space that binds sectors and regions together and relates each year's effort to the succeeding years, impelling us all constantly to greater cooperative endeavour. By strengthening the economic fabric of the country as a whole and of the different regions, it makes a powerful contribution to our goal of national integration.

The Plan gives concrete expression to our national purpose. With its implementation, we shall have advanced yet another stage towards our goal of a prosperous, democratic, modern, socialist society. In meetings of the National Development Council, I have found that all States, irrespective of the political beliefs their Governments hold, have very similar expectations of the Plan. This is so, because our people as a whole have pinned their hopes on the Plan, and want it to succeed, I am confident that they will not spare themselves in a determined effort to ensure that it does succeed.

Indira Gandhi [Prime Minister]

From Chapter 1 Approach and Policy

Aims and Objectives of Planning

1.5. The term 'Socialistic Pattern of Society" was commented upon and elaborated in the Second Five Year Plan document and a long term strategy for economic advance was formulated based on that concept. In the words of the Second Five Year Plan, as quoted in the Third Five Year Plan document:

> "The task before an underdeveloped country is not merely to get better results within the existing framework of economic and social institutions, but to mould and refashion them so that they contribute effectively to the realisation of wider and deeper social values.
>
> "These values or basic objectives have recently been summed up in the phrase “socialist pattern of society”. Essentially, this means that the basic criterion for determining lines of advance must not be private profit, but social gain, and that the pattern of development and the structure of socio-economic relations should be so planned that they result not only in appreciable increases in national income and employment but also in greater equality in incomes and wealth. Major decisions regarding production, distribution, consumption and investment—and in fact all significant socio-economic relationship—must be made by agencies informed by social purpose. The benefits of economic development must accrue more and more to the relatively less privileged class of society, and there should be progressive reduction of the concentration of incomes, wealth and economic power. The problem is to create a milieu in which the small man who has so far had little opportunity of perceiving and participating in the immense possibilities of growth through organised effort is enabled to put in his best in the interests of a higher standard of life for himself and increased prosperity for the country. In the process, he rises in economic and social status. Vertical mobility of labour is thus no less important than horizontal mobility for nothing is more destructive of hope and more inhibitive of effort than a feeling that the accident of birth or of a poor start in life is likely to come in the way of a capable person rising in like in terms of economic and social status ....
>
> "The socialist pattern of society is apt to be regarded as some fixed or rigid pattern. It is not rooted in any doctrine or dogma. Each country has to develop according to its own genius and traditions. Economic and social policy has to be shaped from time to time in the light of historical circumstances. It is neither necessary nor desirable that the economic should become a monolithic type of organisation offering little play for experimentation either as to forms or as to modes of functioning. Nor should expansion of the public sector mean centralisation of decision-making and of exercise of authority. In fact, the aim should be to secure an appropriate devolution of functions and to ensure to public enterprises the fullest freedom to operate within a framework of broad directives or rules of the game….
>
> "....The accent of the socialist pattern of society is on the attainment of positive goals, the raising of living standards, the enlargement of opportunities for all, the promotion of enterprise among the disadvantaged classes and the creation of a sense of partnership among all sections of the community. These positive goals provide the criteria for basic decisions. The directive principles of State policy in the Constitution have indicated the approach in broad terms: the socialist pattern of society is a more concretised expression of this approach. Economic policy and institutional changes have to be planned in a manner that would secure economic advance along democratic and egalitarian lines. Democracy, it has been said, is a way of life rather than a particular set of institutional arrangements. The same could well be said of the socialist pattern."

1.6. The Third Plan stated that "economic activity must be so organised that the tests of production and growth and those of equitable distribution are equally met. A high rate of economic growth sustained over a long period is the essential condition for achieving a rising level of living for all citizens and specially for those in low income groups or lacking the opportunity to work. ...A socialist economy must be efficient, progressive in its approach to science and technology and capable of growing steadily to a level at which the well being of the mass of population can be secured." It was clearly envisaged that "with the rapid expansion of the economy wider opportunities of growth arise for both the public and the private sectors and in many ways their activities are complementary .... The Five Year Plans enlarge the scope for individual initiative, as well as for cooperative and corporate effort .... In the context of the planned development the private sector has a large area in which to develop and expand. It has to function, of course, within the framework of national planning and in harmony with its overall aims, and there must be continuous stress on undertakings in the private .sector acting with an understanding of obligations towards the community as a whole. At the same time it is essential to ensure that the opportunities available in the private sector so not lead to the concentration of economic power in the hands of small numbers of individuals and businesses and that disparities in income and wealth are progressively reduced ..... On behalf of the community as a whole the State has a large responsibility for assessing the wider long-term needs of the nation as against the claims of individuals, sectional or regional interests, and in setting tile goals to be achieved."

1.7. Planning in India has thus to organise the efficient exploitation of the resources of the country, increase production and step up the tempo of economic activity in general and industrial development in particular to the maximum possible extent. The basic goal is a rapid increase in the standard of living of the people, through measures which also promote equality and social justice. Emphasis is placed on the common man, the weaker sections and the less privileged. It is laid down that planning should result in greater equality in income and wealth, that there should be progressive reduction of concentration of incomes, wealth and economic power and that benefits of development should accrue more and more to the relatively less privileged classes of society, and, in particular, the scheduled castes and the scheduled tribes whose economic and educational interests have to be promoted with special care.

1.8. Rapid economic development which is oriented towards establishing social justice must involve refashioning of socio-economic institutions. In part, tile social objectives will be the end result of economic development, but in a large measure their realisation will depend on how the course of development is charted and to what extent an appropriate structure of socio-economic institutions is evolved and operated. The strengthening of democracy in its social and economic aspect has to be attained through this refashioning. It means that major economic decisions and decisions regarding socio-economic relationships will be made by agencies informed with social purpose that there will be a devolution of functions and that there will be scope for experimentation. Democratic values are given effect to by encouraging the growth of a feeling of participation on the part of the small man, the promotion of enterprise among the disadvantaged classes and the creation of a sense of involvement in the transformation of society among all sections of the community. The broad objectives of planning could thus be defined as rapid economic development accompanied by continuous progress towards equality and social justice.

Tempo of Development

1.30. The Fourth Plan has to provide the next step forward in attaining accepted aims and objectives of Indian planning. In formulating it, note has to be taken of the successes and failures so far, the observed continuing trends in the economy and the specific experience of recent years. The most notable lesson is that the current tempo of economic activity is insufficient to provide productive employment to all, extend

the base of social services and bring about significant improvement in living standards of the people. The continuity of even this moderate rate of growth is likely to be threatened if ins ability emerges because of the weakness on the food front and too great a dependence on foreign aid. The Fourth Plan aims at acceleration the tempo of development in conditions of stability and reduced uncertainties. It is proposed to introduce safeguards against the fluctuations of agricultural production as well as the uncertainties of foreign aid in the period of the Fourth Plan. Together with programmes of increased agricultural production the Plan provides for the building of sizeable buffer stocks to even out of supplies of food-trains and other measures to stabilise foodgrain prices and the price level in general. Further in regard 10 the financing of the Plan emphasis is being placed on additional mobilisation of internal resources in a manner which will not give rise to inflationary pressures. The outlays on the Plan are proposed to be closely related to the possibility of raising resources in a non-inflationary way. National self-reliance and growth with stability can be attained only if additional effort is put forward at every level. Dependence on foreign aid will be greatly reduced in the course of the Fourth Plan. It is planned to do away with concessional imports of foodgrains under PL 480 by 1971.* Foreign aid net of debt charges and interest payments will be reduced to about half by the end of the Fourth Plan compared to the current level. Planned increases in production of foodgrains, raw materials and manufactured goods are calculated to make it possible to limit the growth of other imports to manageable proportions. A sustained increase of exports by about 7 per cent a year is another essential element of strategy in the Fourth Plan to secure balance on foreign account and approach speedily towards the goal of self-reliance.

1.31. These measures which seek to limit the extent of foreign aid and to avoid inflationary financing have influenced the total investment outlays proposed in the Plan. The resource position having improved it is possible to increase investment in public sector industrial activity, although the outlays will still be modest. It is hoped, however, that even with these outlays the tempo' of economic activity will be stepped up significantly in the initial years of the Plan, If the performance is better, the Plan outlays in later years could be larger than provided for now. Success depends essentially on the extent of internal effort made in saving and investment and on the operational efficiency and economic discipline displayed by official and non-official agencies and establishments. In this context special attention needs to be paid to the public sector where investment is expected to reach 60 per cent of the total. The original expectation of an expanding public sector yielding, in due course, substantial resources for its continued development have not been realised.

from Chapter 2 The Long Term Perspective

2.41. Manpower Planning.—Some of the important decisions which need to be taken in the immediate future for fulfilling the physical targets of agriculture and industry have been outlined earlier. Manpower planning is another critical area where long-term requirements will have to determine current decisions. The decisions on the intake capacity in engineering and medical education are cases in point. The expansion of training facilities during the Third Plan has been on a scale which has eliminated the risk of quantitative shortages of engineering and medical personnel during the Fourth Plan. With marginal adjustments in the intake capacity of the institutions, the requirements during the Fifth Plan are expected to be met. The emergence of temporary imbalances of supply and demand should not be allowed to influence admissions to long duration courses: these judgments, based as they are on current market conditions, are net relevant to evaluating the supply and demand position several years ahead when the trainees will be seeking jobs. A long-term view of development of the economy can alone provide guidance for such calculations. Even then the task of analysis is by no means simple. There is need for sharpening the tools and techniques relevant to manpower planning and making a periodic review of demand for specialised personnel and their training requirement both in numbers as well as quality.

2.42. Fresh thought needs to be given to the effective training of large numbers of middle level personnel oriented to the changing requirement of dynamic development and modernisation of the economy. Such training should aim at developing the creative ability of individuals, equipping them for effectively performing their tasks in life and motivating them to serve the best interests- of society. '

2.43. Design Organisation—Self-reliance in the technological sense implies the existence and effective functioning of indigenous organisations for design, construction and engineering of projects as well as capability for design and development of machinery, equipment and instruments indigenously manufactured. At present there is unwholesome dependence on foreign agencies for these services. As long as this deficiency remains, local talent will not have the scope to develop, and dependence on foreign help will be prolonged. It will expose development to uncertainties, besides involving an avoidable and large drain of foreign exchange resources. The capacity of the country to undertake large development projects on the basis of indigenous talent will not be developed despite very large expenditure on complex projects and precious time will be lost by not fully availing of the learning opportunities offered by these projects. It is only by participating actively and in positions of responsibility that skills and confidence are generated and scarce, high talent human resource is developed. It is, therefore, of importance for the future that urgent attention is given to promoting and encouraging healthy development of adequate design and engineering organisations, staffed by qualified personnel and working under proper technical leadership. Wherever competent organisations exist, they should be ensured adequate work.

from Chapter 14 Industry

14.4. In spite of this rather uneven performance significant achievements contributing towards the realisation of diversified industrial structure were made during this period [1963-68]. Substantial capacity has been created in many new lines. A fairly sound base for future growth has been laid. Several of the large projects initiated at the commencement of the Third Plan have been completed and brought into production. In particular, in the field of heavy engineering and machine building industries, the commencement of production of the different units in the Heavy Engineering Corporation, Mining and Allied Machinery Corporation and of heavy electrical projects has now made it possible, largely through indigenous effort, the expansion, of further capacity in vi al sectors like iron and steel, mining and power generation. In the field of rail and road transport and communications, virtual self-sufficiency for the supply of equipment and rolling stock has been realised. Machinery manufacturing capacity for a variety of traditional industries like textiles, sugar and cement has been developed. Design and engineering capabilities have been expanded. Process technology has been either acquired or developed to enable the planning, designing and construction of industrial projects with maximum indigenous effort in fields like fertilisers, rayon and dissolving pulp. There has been appreciable increase in the production capacity of steel and non-ferrous metals. Progress has also been made in the expansion of capacity in petroleum, fertiliser, and petro-chemical industries. In wide range of industries, it will be possible merely by the fuller utilisation of existing capacity—as distinguished from new investment to achieve substantially higher levels of production in the initial years of the Fourth Plan.

Approach

14.12. There is first the need to achieve speedy self-reliance. With investment growing at a higher rate than aggregate income and given the rapid expansion of demand for manufactured inputs going into agriculture, the economy's requirements of capital equipment, metals, petroleum products and chemicals are growing fast. It is in these areas that dependence on imports is specially large. Consequently, the projected developments along with a progressive movement towards self-reliance necessitate a relatively faster expansion of the domestic production in these industries over the next decade or so. These industries are capital intensive and the optimum size of the units is relatively large. While the compulsion of

circumstances makes it necessary to devote a substantial part of resources available for industrial development to such large and capital intensive industries, it is necessary to bear in mind that capital is a scarce resource in the economy.

Licensing Policy

14.18. Both from the point of view of accelerating industrial development and improving administrative efficiency, a review of the system of controls has been considered necessary. The primary purpose of control is to ensure proper allocation of scarce resources. Regulation of industrial development has to be considered primarily in relation to the allocation of foreign exchange. Thus, import control and control on commodities in short supply would have to continue. Within the broad frame-work of control in strategic areas there is advantage in allowing the market much fuller play. The supply of a variety of industrial commodities has considerably eased and the need is one of stimulating demand and production. With the broader industrial base and growing availability of capital equipment and raw materials from within the country, the need to control further expansion in industries which are largely based on domestic resources has assumed less importance. Accordingly, the Draft Fourth Five Year Plan suggested the following industrial licensing policy:

(1) all basic and strategic industries, involving significant investments or foreign exchange should be carefully planned and subjected to industrial licensing. It is necessary to ensure effective performance and to keep a close watch on the development of these industries. Hence, once the licence is granted, credit, foreign exchange and scarce raw materials would be earmarked for them and made available in time. This should be done for units both in the public and the private sectors;

…

Foreign Collaboration

14.28. The basic policy in regard to foreign collaboration and foreign investment has been laid down and docs not call for any material modification. In the detailed application of this policy, care has to be taken to ensure that foreign collaboration is resorted to only for meeting a critical gap and does not inhibit the maximum utilisation of domestic know-how and services. Thus, for example, foreign collaboration in the production of consumer goods, whether they can be produced within the country or not, will not ordinarily be permitted except in the interest of larger exports. Collaboration in directions in which indigenous effort can within a short time provide the services or goods or a substitute, ought not to be allowed. It is necessary to subject every proposal for foreign collaboration to fairly rigid tests. Import of foreign know-how particularly in sophisticated industrial fields would continue to be required. Even here, it would be essential to make simultaneous efforts for the adaptation of such know-how through indigenous effort and to improve on it to avoid the need for future purchases. In order to identify the fields in which foreign collaboration is required and to streamline the procedure for acceptance or otherwise of foreign collaboration proposals, a Foreign Investment Board has been set up. Broad guidelines regarding the terms on which foreign collaboration might be permitted have been indicated.

*Note added by MJ Peterson: PL (Public Law) 480 was the United States law authorizing provision of food aid at no or low cost to developing countries. India's use of such aid was so widespread during the droughts of the early 1960s that nearly all Indians would have understood the reference.

Government of India
TENTH FIVE YEAR PLAN : 2002-07

[From Government of India Planning Commission website, http://planningcommission.nic.in/plans/planrel/fiveyr/default.html accessed January 2008]

FOREWORD

I have a vision of an India free of poverty, illiteracy and homelessness – free of regional, social and gender disparities – with modern physical and social infrastructure – and a healthy and sustainable environment. Above all, an India which stands tall and proud in the comity of nations, confident in her capability to face all possible challenges. In short, I dream of an India which is counted among the ranks of developed nations before the end of the second decade of this new century.

The most pressing challenge facing us in the coming years will be to provide every Indian with the opportunity to realize his or her full creative potential. Demographic trends indicate that the rate of growth of our working age population during the next ten years will be the highest we have ever experienced, and unless we achieve a significant improvement in the pace of creation of work opportunities, there will be an increase in the level of unemployment. Such a situation cannot be allowed to materialize.

Unemployment not only entails high human costs, it can also lead to serious social disruption, and put enormous strain on the fabric of our society. More importantly, the youth of our country is our most valuable resource and there can be no greater shame than to let it go waste for the lack of will and determination. Future generations will not forgive us for opportunities lost. We have, therefore, made a commitment to the young people of this country that our economy will generate one crore work opportunities each year for the next ten years so that their talents and potentials are utilized for the benefit of the Nation.

These dreams cannot be realized without rapid growth and development. We must, therefore, explore every conceivable way to accelerate the rate of growth of the economy. We must collectively show the firm resolve to actualize the latent potentialities of our great country, putting behind all doubts and differences.

Planning has been one of the pillars of our approach to economic development since independence, and has stood us in good stead. Planning is not a static concept, and each of our Plans has reflected the changing imperatives of the times. The Tenth Plan carries forward this tradition.

While working out the road-map we need to follow to realize my vision of doubling the per capita income of our country and providing one crore work opportunities in the next ten years, the Planning Commission has firmly kept in view the ongoing process of transition to a market economy. The changing role of the Government and its relationship with the private sector, forms the cornerstone of the Plan.

There are four dimensions of this transformation that I consider to be of critical importance, which need to be guided at the highest political level.

First and foremost is the centrality of good governance to the development process. The best policies and programmes can flounder on the rock of poor governance and shortcomings in implementation. The Tenth Plan document has highlighted this issue by focusing on governance and implementation in a significant

manner. We need to bring about dramatic improvements in the functioning of our administrative, judicial and internal security systems in order to foster a dynamic and vibrant market economy.

Second, over the years, we have created numerous barriers to inter-state, and even intra-state, trade and commerce. Creation of a common economic space is one of the basic advantages of nationhood. All over the world, countries are coming together for this purpose, but we have continued to maintain and erect barriers. We must reverse this process decisively.

Third, we have inherited from the past a wide range of controls and restrictions on entrepreneurial initiatives, which have retarded the emergence of an investor-friendly climate in the country. We must shed the mind-set of shortages that had given birth to this regime of pervasive controls, and create an environment which welcomes entrepreneurship with open arms.

Finally, effective delivery of basic social services to our people cannot be ensured unless the institutions that are charged with these functions are made accountable to the people themselves. For this it is necessary to empower the Panchayati Raj Institutions by transferring to them both functions and resources. The Panchayati Raj Institutions must become the cutting edge of our three-tier political structure and the focal point of democratic decentralization.

The unanimous adoption of the Tenth Five Year Plan by the National Development Council is an affirmation of our collective belief in the potential of our country and the extent to which we share a common vision of our future. I congratulate the Deputy Chairman, Members and officials of the Planning Commission for having done a commendable job in shaping and giving substance to this shared vision. I would like to express my appreciation for the contribution made by a wide cross-section of our political leadership, representatives of civil society, academics, industrialists, and individuals from various walks of life, in this truly National effort. The process of Plan formulation encapsulates our deep commitment to democracy and the consultative process that form the core of our National ethos.

It is, however, important that we effectively communicate the goals, strategies and tasks of the Tenth Plan to the various constituencies of our diverse society, without whose support we cannot hope to move ahead rapidly. We need to generate enthusiasm about the Plan and its targets among our people, especially our youth. We can achieve these ambitious targets only when we are able to make development a people's movement, and the Tenth Plan a people's Plan. I seek the cooperation of all political parties, social organizations, voluntary agencies and the media in this important endeavour.

Atal Bihari Vajpayee

Prime Minister of India, and
Chairman, Planning Commission

New Delhi

December 21, 2002

Bhopal Plant Disaster
Appendix D: Union Carbide Corporation

by MJ Peterson
Revised March 3, 2008

Appendix Contents:

References used in this section:

Thomas J. Lueck, "1982 report cited safety problems at plant in India, *The New York Times*. December 11, 1984. UMass internet users go here: http://proquest.umi.com.silk.library.umass.edu:2048/pqdweb?did=120505048&sid=1&Fmt=10&clientId=2724&RQT=309&VName=HNP

Kenneth B. Noble. "U.S. agency cites Carbide for 'willful neglect' on plant leak," *The New York Times*. October 2, 1985.

Philip Shabecoff, "Union Carbide had been told of leak danger," *The New York Times*. January 25, 1985. [focuses on conditions in UCC's West Virginia plant]
UMass internet users go here:
http://proquest.umi.com.silk.library.umass.edu:2048/pqdweb?did=119135082&sid=1&Fmt=10&clientId=2724&RQT=309&VName=HNP.

Additional Readings:

Union Carbide Website: www.unioncarbide.com

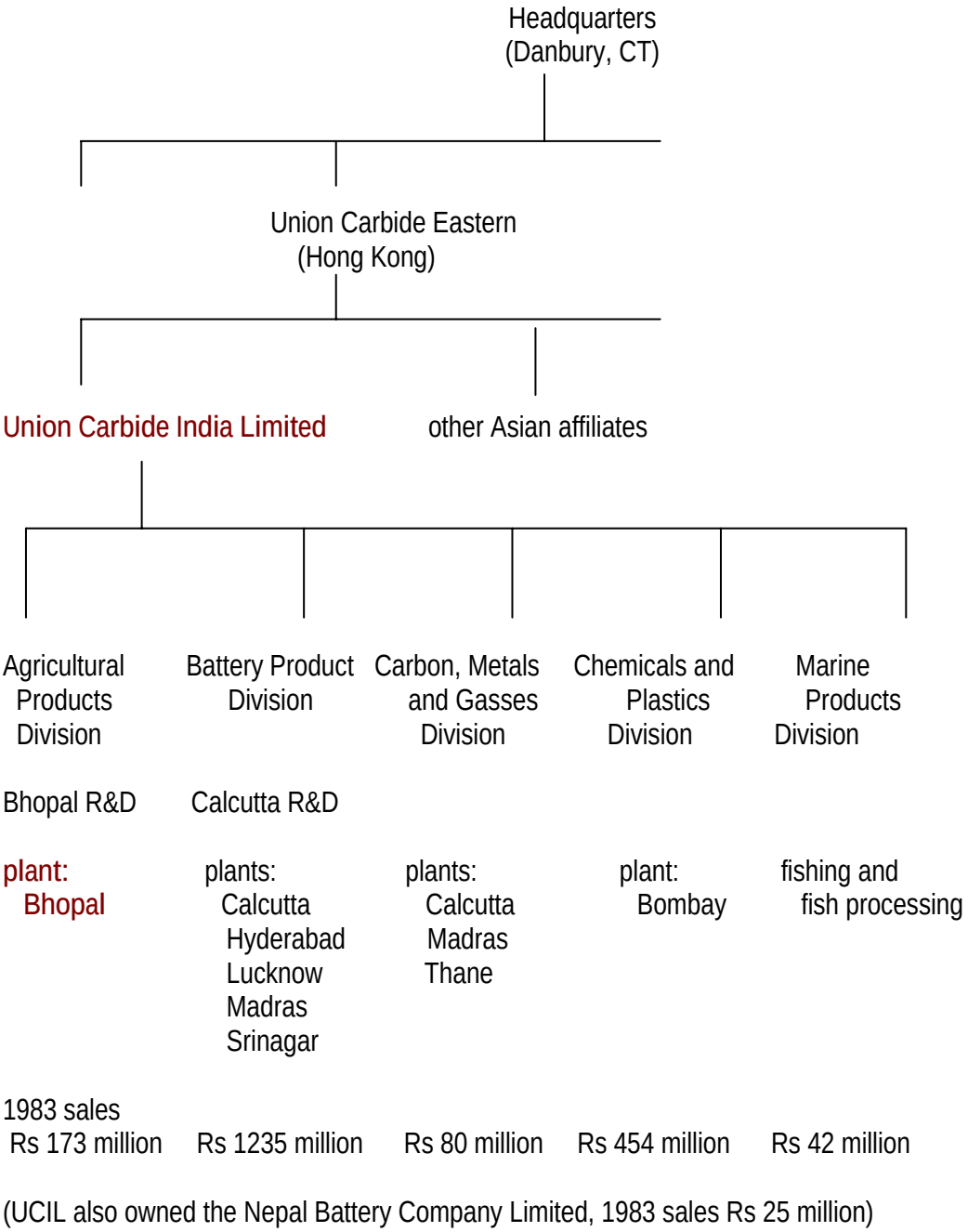
This case was created by the International Dimensions of Ethics Education in Science and Engineering (IDEESE) Project at the University of Massachusetts Amherst with support from the National Science Foundation under grant number 0734887. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. More information about the IDEESE and copies of its modules can be found at http://www.umass.edu/sts/ethics.

Wil Lepkowski, “The Restructuring of Union Carbide since Bhopal,” in Sheila Jasanoff, ed.., *Learning from Disaster: Risk Management after Bhopal* (Philadelphia: University of Pennsylvania Press, 1994).

Richard Ice, “Corporate publics and rhetorical strategies: The case of Union Carbide’s Bhopal Crisis,” *Management Communications Quarterly* 4/3: 341-362 (Feb 1991). [Probably overestimates how well Union Carbide did with some of the audiences, but has an interesting classification of audiences and analysis of how rhetoric that worked with some undermined efforts to persuade others.]

Organization Chart

Union Carbide Corporation, 1982



(UCIL also owned the Nepal Battery Company Limited, 1983 sales Rs 25 million)

Summary of 1982 Union Carbide Safety Survey of Bhopal Plant

Overall conclusion: “no situations involving immanent danger or requiring immediate correction” but situations present that do require attention and remediation.

10 conclusions are listed as particular concerns:

1. Potential for gas leaks in phosgene/MIC production area

2. Potential for gas leaks in MIC storage area

3. Lack of fixed water-spray protection systems in several parts of the plant

4. Potential for overfilling, excess pressure or contamination in MIC storage tanks

5. Deficiencies (including leaks) in safety valves

6. Malfunctioning pressure gauges

7. Inadequate instrument maintenance programs

8. Maintenance workers’ failures to insert slip blinds into pipes before starting water washing to clean filters

9. Problems stemming from high personnel turnover, particularly in operations teams

10. Lack of contingency plans for coping with serious leaks

Summary of 1985 Inspection of West Virginia Plant

In April 1986 the U.S. Occupational Safety and Health Administration (OSHA) proposed a $1.4 million fine against Union Carbide Corporation for their disregard of health and safety laws. The violations were publicized after a September 1985 inspection of five of 18 plant units at Institute, West Virginia alleged 221 violations of 55 health and safety laws. OSHA classified 72 of the 221 violations as "serious," meaning there was substantial probability of death or substantial physical harm.

An October 1985 *New York Times* article cited the “Willful” violations as:

- Negligently exposing six workers to toxic chemicals within the plant.
- Failure to follow standard company operating procedures in the storage and transfer of toxic chemicals, as well as company emergency procedures.
- Failure to provide an adequate number of respirators accessible to workers handling toxic chemicals.

Other violations included:

- An inadequately ventilated control room. Air conditioning equipment brought vapors into the control room.

International Dimensions of Ethics Education in Science and Engineering
Case Study Series

Bhopal Plant Disaster
Appendix E: Issues in Chemical Processing

by MJ Peterson
Revised March 11, 2008

Appendix Contents:

References used in this section:

Paul Shrivastava, *Managing Industrial Crises: Lessons of Bhopal* New Delhi: Vision Books, 1987 [an early sober analysis of the causes and how to avoid similar problems by a US-based academic born in Bhopal]

United States Government, Hazardous Substances Data Base

United States Government, Agency for Toxic Substances & Disease Registry

Additional readings:

Baldave Singh, "Bhopal's legacy: Indian producers feel cornered," *Chemical Week* 159/26 pp. 84- (2 July 1997) [Indian chemical firms' reactions to pressures that they sign on to privately-sponsored "Responsible Care" operating standards code of conduct.]

This case was created by the International Dimensions of Ethics Education in Science and Engineering (IDEESE) Project at the University of Massachusetts Amherst with support from the National Science Foundation under grant number 0734887. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. More information about the IDEESE and copies of its modules can be found at http://www.umass.edu/sts/ethics.

Toxicity of Chemicals present in the Bhopal Plant

These entries from US government public databases notes reflect 2008 understanding of the toxicity, health effects, and best ways of treating persons exposed to the various chemicals involved in producing UCC's "Sevin" pesticide.

Physicians, nurses, and other emergency personnel in Bhopal had little information about either the composition of the gas cloud or the best ways of treating patients exposed to Methyl Isocyanate (MIC). A communication from a UCC staff physician at the West Virginia plant the day after the leak provided some information, including an instruction for treatment in the event cyanide poisoning was suspected. A long controversy about whether the suggested treatment should have been followed with all or some of the victims broke out, and to this day there is disagreement about whether cyanide poisoning occurred and whether this treatment would have helped the recovery of those exposed to the gas cloud.

Two links are given for most of the chemicals. The first link is to the Hazardous Substances Data Bank (HSBD). Type in the name of the chemical of interest and HSBD will give toxicity information and a chemical fact sheet with extensive information on the chemical's physical characteristics. The second links are from the Agency for Toxic Substances & Disease Registry (ATSDR), which show the chemical makeup and toxicity, and provide medical guidelines for treating persons who have been exposed to unhealthy levels of the chemical. ATSDR links go directly to the chemical of interest.

1. MIC:
   HSBD: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.htm
   ATSDR: http://www.atsdr.cdc.gov/MHMI/mmg182.pdf

2. Phosgene:
   HSDB: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.htm
   ATSDR: http://www.atsdr.cdc.gov/MHMI/mmg176.pdf

3. Chlorine:
   HSDB: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.htm
   ATSDR: http://www.atsdr.cdc.gov/MHMI/mmg172.pdf

4. Alpha-Naphthol
   HSDB: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.htm
   ATSDR: http://www.atsdr.cdc.gov/toxprofiles/phs67.html (*a Public Health Statement*)

5. Methylamine
   HSDB: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.htm

6. Carbaryl (Sevin)
   HSDB: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.htm

   This Chemical Fact Sheet for Carbaryl (Sevin) (the end-product insecticide produced at Bhopal) focuses mainly on hazards encountered in its ordinary use in diluted concentrations as a pesticide. The "Summary Science Statement" towards the bottom lists it as having "a moderate to low mammalian toxicity." http://pmep.cce.cornell.edu/profiles/insect-mite/cadusafos-cyromazine/carbaryl/insect-prof-carbaryl.html

Fragmentary Notes on Chemical Processes for Producing SEVIN (Carbaryl Pesticide)

[MJ Peterson ver.2 27 Feb 2008]

ALTERNATIVE METHODS FOR PRODUCING SEVIN

Prior to 1968:

a) phosgene + alpha-napthol → ??
b) ?? + methylamine → SEVIN + a toxic residue+ other waste products

This suggests some advantages to using the MIC process. Though MIC is very toxic, the overall reaction produces less undesirable residue and fewer waste products.

UCC process 1968:

a) phosgene + methylamine → methyl isocyanate
b) methyl isocyanate + alpha-napthol → SEVIN

"The process (to make Sevin) uses a cost efficient one step-process using the highly toxic methyl isocyanate gas."

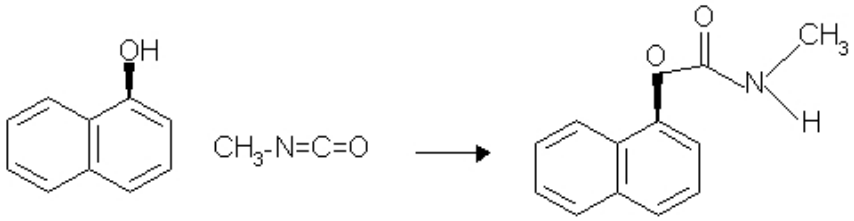


Image and quote from: http://www.chm.bris.ac.uk/webprojects2002/tan/bhopal_disaster.htm

UCIL's original proposal for SEVIN production in Bhopal plant

1. UCIL will make alpha-napthol by its own process of (see drawing 1)
   a) Napthelene + Chlorosulfonic acid → Sulfuryl Chloride
   b) Sulfuryl Chloride → alpha-napthol

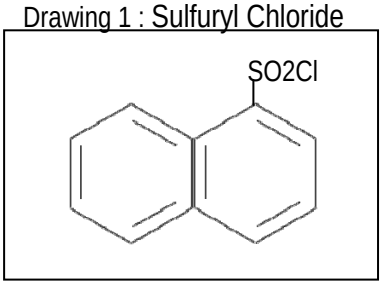
2. Will produce phosgene by making carbon monoxide in plant then combining it with chlorine to form phosgene.

3. Then produce MIC using UCC process of
   a) Methylamine + Phosgene → Methylcarbamoyl chloride
   b) Methylcarbamoyl chloride + ? → Methyl Isocyanate

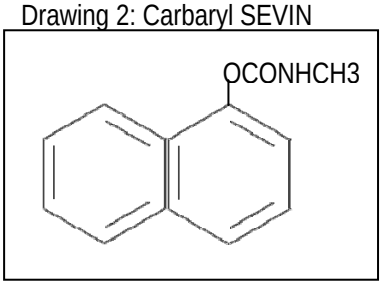
   [a different account lists phosgene + monomethylamine → MIC]

4. Then mix alpha-napthol + MIC → carbaryl SEVIN (drawing 2 or image above)

Drawing 1 : Sulfuryl Chloride



Drawing 2: Carbaryl SEVIN



In the 1960s and 1970s there were two ways to operate an MIC-based carbaryl production process:

a) make MIC in advance, put it in bulk storage, draw from bulk storage as final production proceeds. This was Union Carbide's choice for West Virginia and Bhopal plants.

b) make smaller batches ahead of production need and store in smaller tanks or drums. Used by Bayer A.G. in Germany, where plant never stored more than 10 tons of MIC and divided it among 4 separate storage tanks.

This should have been feasible for Bhopal plant, and some very anti-corporate sources even claim that UCIL proposed using a method more like this but that UCC preferred to base the Bhopal plant design on its West Virginia process.

By 1984 there was also

c) use a closed cycle production system with newly-made MIC piped straight to mixing with alpha-napthol. Mitsubishi was using this process in 1984 and DuPont was building it into a plant in Texas in early 1985.

This appears to be very capital-intensive and only workable if one has reliable power supply and very good computer control systems. Those features would make it unfeasible for the Bhopal plant. [Note by MJP: I would not be surprised to learn it was developed only after the Bhopal plant design was chosen in the mid-1970s.]

By 1984 Bayer A.G. was producing MIC with the less toxic component chemicals dimethylurea and diphenylcarbonate, but the resulting MIC was no less toxic. It is not clear whether this process was under patent. Having to license from Bayer would raise costs to UCC or UCIL and also weaken the impression of technological competence they needed to maintain vis-à-vis the Governments of India and Madhya Pradesh.

Data on Toxicity

1976 Union Carbide Manual:

- chlorine, phosgene, monomethylamine and MIC all known to be deadly in sufficient concentrations.
- MIC listed as "relative, toxic, volatile, flammable."
- maximum safe workplace exposure is listed as 0.2 parts per million over an 8 hour period

Current Chemical Fact Sheet for Carbaryl (Sevin) the end-product insecticide produced at Bhopal: http://pmep.cce.cornell.edu/profiles/insect-mite/cadusafos-cyromazine/carbaryl/insect-prof-carbaryl.html

Types of Hazard in Manufacture and Use of Industrial Products

Classification of Production System, Production Environment, and Post-Production Effects inspired by Paul Srivastava, *Managing Industrial Crises: Lessons of Bhopal* New Delhi: Vision Books, 1987. Pre-Production Effects and color scheme by MJ Peterson, 17 Jan 2008.

Key

Red = traditional concerns of industrial process design
Green = concerns added with rise of environmental awareness and environmental protection legislation
Blue = nontraditional concerns suggested by ethical concern for humans and Earth

Pre-Production Effects

(potential impacts of extracting and transporting raw materials, processed materials, or assembled components used as inputs to production facility)

- personal injury
- pollution
- transportation incident

Production System

(potential impacts of using the machines and other equipment included in basic design of the production process to be used)

- personal injury
- transportation incident
- system failure

Production Environment

(potential impacts of production activity in the production facility)

- occupational disease
- workplace hazard

Post-Production Effects

(potential impacts of emissions and/or wastes resulting from production activity)

- environmental pollution
- toxic waste disposal

Types of Hazard in Product Use/Consumption

built out from Paul Shrivastava, *Managing Industrial Crises: Lessons of Bhopal* New Delhi: Vision Books, 1987. Color scheme by MJ Peterson, 17 Jan 2008.

Key

Red = traditional concerns of industrial process design
Green = concerns added with rise of environmental awareness and environmental protection legislation
Blue = nontraditional concerns suggested by ethical concern for humans and Earth

Product Misuse

- intentional (user aware of and ignores warnings against alternate use)
- unknowing (user unaware of safety warnings)
- accidental (user aware of safety warnings but makes error in using)

Product Defect

- design error
- assembly error

Product Sabotage

- inside plant
- outside plant

International Dimensions of Ethics Education in Science and Engineering
Case Study Series

Bhopal Plant Disaster
Appendix F: Assessing Responsibility: The Legal/Regulatory System

by MJ Peterson
Revised March 3, 2008

Appendix Contents:

References used in this section:

Josee van Eijndhoven, "Disaster prevention in Europe" in Sheila Jasenoff ed, *Learning from Disaster: Risk Management after Bhopal* (Philadelphia: University of Pennsylvania Press, 1994) pp. 113-132

Susan G. Hadden, "Citizen Participation in Environmental Policy Making" in Sheila Jasenoff ed, *Learning from Disaster: Risk Management after Bhopal* (Philadelphia: University of Pennsylvania Press, 1994), pp. 91-112.

Sanjoy Hazarika, *Bhopal: The Lessons of a Tragedy* (New Delhi: Penguin Books India Pvt Ltd, 1987)

Indian Law Institute, *Mass Disasters and International Liability: The Bhopal Case,* Bombay: N.M. Tripathi Private Ltd. 1986

This case was created by the International Dimensions of Ethics Education in Science and Engineering (IDEESE) Project at the University of Massachusetts Amherst with support from the National Science Foundation under grant number 0734887. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. More information about the IDEESE and copies of its modules can be found at http://www.umass.edu/sts/ethics.

Additional readings:

Links to Supreme Court of India decisions:

Decision of February 1989 by Supreme Court Panel accepting the Settlement:
http://www.judis.nic.in/supremecourt/qrydisp.aspx?filename=8035

Decision of May 1989 providing additional rationale for accepting the settlement:
http://www.judis.nic.in/supremecourt/qrydisp.aspx?filename=7916

Decision of December 1989 rejecting challenges to the Bhopal Gas Disaster Relief Act of 1985 establishing the Government of India as sole legal representative of the victims (upholding the challenges would have allowed private lawsuits suspended in 1985-86 to proceed and victim advocates hoped to do this to overturn the settlement):
http://www.judis.nic.in/supremecourt/qrydisp.aspx?filename=7699

Decision of 1991 by full Supreme Court upholding 1989 decisions against appeals. This decision added the three elements to the 1989 settlement:
http://www.judis.nic.in/supremecourt/qrydisp.aspx?filename=12603

Update on US Court Proceedings:

US Federal District Court ruling on Bano v. Union Carbide Corp. Ruling summarized briefly in *New York Law Journal* Oct 14, 2005.

Comments on legal proceedings:

Mark A. Chinen, "Jurisdiction: foreign plaintiffs, forum non conveniens, and litigation against multinational corporations." *Harvard International Law Journal* 28/1: 202-209 (winter 1987).

Monroe Leigh. "Federal jurisdiction - forum non conveniens - review of conditions of dismissal imposed by trial court - no need to require consent to enforceability of foreign judgment - equal access of parties to evidence under applicable discovery rules." *American Journal of International Law* 81/2: 415-417 (April 1987).

On regulatory changes:

Sheila Jasanoff, ed. *Learning from Disaster: Risk Management after Bhopal.* Philadelphia: University of Pennsylvania Press, 1994. [wide-ranging collection addressing various aspects of regulatory changes]

G. Joseph, M. Kasniak, and L. Long, “Lessons after Bhopal: CSB as a Catalyst for change,” *Journal of Loss Prevention in the Process Industries* 18/4-6:357-348 (2005). [discusses experiences of the US Chemical Safety Board]

Ronald J. Willey, Daniel A Crowl, and Wil Lepkowski, “The Bhopal Tragedy: Its influence on process and community safety as practiced in the United States,” *Journal of Loss Prevention in the Process Industries* 18/4-6, pp 365-374 (July-Nov. 2005). [a more general summary of effects on US regulatory practice]

Indian Supreme Court Decisions on the Bhopal Disaster

John P. Ake and MJ Peterson
ver.2, 10 Mar. 2008

With the 1986 US federal court ruling that all lawsuits claiming compensation for harm suffered in the Bhopal disaster should be handled by Indian courts, the Indian Supreme Court took the lead in handling the litigation. It could start from the fact that the Indian Parliament had adopted special legislation in the Bhopal Gas Leak Relief Act of 1985 naming the Government of India as sole legal representative of all victims. This step had been taken to consolidate all claims, regardless of whether they were to be pursued in US or Indian courts, and greatly simplified the tort law proceedings in India. Though prepared to hear the case, the Supreme Court urged the Government and Union Carbide to resume the negotiations broken off before the US decision in 1986 and come to a general settlement. A settlement was reached but was sufficiently controversial that the case remained in litigation for an additional two years. This was possible because under Indian law, cases before the Supreme Court are typically heard by a panel rather than the full 26-member court. Those who lose their case in the panel may appeal to the full court for a ruling setting aside the panel's judgment.

This note summarizes the various decisions and provides links to their official text on the Supreme Court of India's website.

1. Supreme Court Decision (by the initial panel), February 14, 1989. The panel formally endorsed the settlement it had urged the Indian government to accept, payment of $470 million from Union Carbide as final settlement of all past, present, and future claims arising from Bhopal. The panel also exercised its extraordinary jurisdiction to terminate all the collateral criminal, civil, and contempt of court proceedings then pending in lower Indian courts. Union Carbide, which had been required to maintain money in escrow in anticipation of settlement, paid the money to the Government within 10 days.

   URL: http://www.judis.nic.in/supremecourt/qrydisp.aspx?filename=8035

   This decision was extremely unpopular; victim advocates had long maintained that a minimum acceptable settlement would involve payment of $3 billion in compensation. Prime Minister V.P. Singh, head of a government having only minority support in Parliament and soon voted out, protested, set the Carbide money aside, began paying compensation to victims from the Indian treasury, and asked the Court to rescind the settlement.

2. Supreme Court Decision, May 1989. In response to the Prime Minister's actions, the Supreme Court of India issued an additional opinion explaining the rationale for the settlement. It emphasized that compensation levels involved were substantially higher than those ordinarily payable under Indian law.

   URL: http://www.judis.nic.in/supremecourt/qrydisp.aspx?filename=7916

   Victim advocates then attempted to reopen the possibility of pursuing lawsuits by challenging the government's position as sole legal representative.

3. Supreme Court Decision, December 1989. The Supreme Court upheld the validity of the "Bhopal Gas Leak Disaster Act of 1985," thereby closing off this possibility.

   URL: http://www.judis.nic.in/supremecourt/qrydisp.aspx?filename=7699

   Union Carbide on various points, and victims and advocates on others, then invoked the last legal resort and appealed to the full Supreme Court.

4. Supreme Court Decision, October 1991. The full Supreme Court dismissed all petitions seeking review of the settlement, upheld the civil settlement of $470 million in its entirety, but set aside the portion of the 1989 decision that quashed criminal prosecutions pending in Indian Courts at the time of settlement. The Supreme Court further:

   a. Required the Government of India to purchase, out of the settlement fund, a group medical insurance policy to cover 100,000 persons who may later develop symptoms;
   b. Required Government of India to make up any shortfall, however unlikely, in the settlement fund from public funds;
   c. Specified certain aspects of the mode of administering the settlement fund; and
   d. Took up the repeated offers of UCC and UCIL to fund a hospital in Bhopal by instructing them to fund construction and eight years of operating costs of a specialist hospital in Bhopal to be built on land donated by the state government. They agreed to fund the hospital; UCC provided the money from proceeds of sale of its 50.9% stake in UCIL to a third company in addition to the $470 million settlement payment.

   URL: http://www.judis.nic.in/supremecourt/qrydisp.aspx?filename=12603

5. Supreme Court Decision, December 1986: Although it was not part of the Bhopal litigation, the Indian Supreme Court's December 1986 ruling in M.C. Mehta and Anr. v. Union of India and Ors. ("the Sriram Case") is also relevant. In that case, the Supreme Court ruled that a corporation engaged in "a hazardous and inherently dangerous" business is "absolutely liable" for all damage caused by accidents during its operations. This case arose from a leak from an Indian company's chemical plant that caused a few injuries in New Delhi about a year after the Bhopal leak. It was widely viewed as having been decided with the pending Bhopal litigation in mind, though was not directly cited in the rulings endorsing the settlement. It is often mentioned by advocates of discouraging operations – or at least carelessness – by imposing heavy compensatory and punitive damages on multinational corporations operating in developing countries.

   URL: http://www.judis.nic.in/supremecourt/qrydisp.aspx?filename=8858

Update: Further US Litigation related to the Bhopal Disaster

The Indian Supreme Court's 1991 decision did not end the legal wrangling. Continued dissatisfaction with the results left emotions raw. The portion of the 1991 decision reinstating criminal charges against Warren Anderson and 8 UCIL executives and supervisors, and ongoing controversies about cleanup of the plant site suggested further avenues for suit in the USA.

The first effort, a set of cases consolidated into Janki Bai Sahu v. Union Carbide Corporation and Warren Anderson, sought to reopen the case under the US Alien Tort Claims Act, which permits civil suits regarding harm done abroad by US nationals or by foreigners to US nationals. The same judge who ruled that the cases should be tried in India heard this case and in the course of ruling on preliminary motions maintained the view that the Indian Supreme Court's ruling disposes of the matter.

See:

1.) Sahu v. Union Carbide Corp., 04 Civ. 8825 (JFK) , United States District Court for the Southern District of New York, 418 F. Supp. 2d 407; 2005 U.S. Dist. LEXIS 31202, December 1, 2005, Decided , December 1, 2005, Filed

    Result -Plaintiffs, class members, filed a class action complaint against defendants, a corporation and its former chief executive officer (CEO), and alleged environmental pollution in and around the corporation's former plant in Bhopal, India. The class sought recovery for injuries they alleged were sustained by the pollution. All claims except corporate veil piercing are dismissed.

2.) Sahu v. Union Carbide Corp., Docket No. 05-6944-cv , United States Court of Appeals for the Second Circuit, 475 F.3d 465; 2007 U.S. App. LEXIS 923; 37 ELR 20018, November 15, 2006, Argued , January 17, 2007, Decided

    Result -Carbide's motion to have plaintiff's case for corporate veil piercing dismissed is granted.

More recently, the victims' lawyers have sought to reopen the issue by focusing on post-leak contamination, an issue they claim is not covered by the Indian Supreme Court rulings. The main case here is Jagarnath Sahu et al. v. Union Carbide Corporation and Warren Anderson et al., a class action suit filed in March 2007, seeking financial compensation for costs of cleaning up six individual properties allegedly polluted by contaminants from the Bhopal plant as well as the remediation of property in 16 colonies adjoining the plant. Suit has been stayed pending resolution of appeal in Janki Bai Sahu case. This is the legal side of the international activists' campaign against Dow Chemical Company, the current owner of Union Carbide.

This link is to the docket on the case, which indicates its preliminary status:
http://dockets.justia.com/docket/court-nysdce/case_no-1:2007cv02156/case_id-302312/

Western European Policy on Information about Chemical Plant Hazards, 1982-

from Josee van Eijndhoven, "Disaster prevention in Europe" in Sheila Jasenoff ed, *Learning from Disaster: Risk Management after Bhopal* (Philadelphia: University of Pennsylvania Press, 1994) pp. 113-132

[note: references to "Europe" mean Western European countries]

Risk regulation has developed somewhat differently in Europe than in either the United States or India. Two important explanatory variables are differences in regulatory strategy and differences in the incidents that shaped public attention to hazards. With respect to strategy, most European countries, unlike the United States, require that a license be granted for a chemical plant to start operating. … A licensing system tends to shift the burden of proof on safety to an early point in time, namely to a moment before operations have started. Debate on the acceptability of a plant's effects on its employees or its environment become part of the process of starting up the plant. A licensing system also shifts the responsibility for the safety of the plant in the sense that the authorities, in granting a license, accept that the plant can be safely operated.

The second difference between Europe and the United States is related to the accidents that have influenced policy. I argue in this chapter that the actual shape of disasters and the perception of their cause and relevance are very important in determining the reaction to them. The major accidents, most notably Bhopal, that helped shape risk management in other parts of the world were not nearly so important in Europe. … The 1976 Seveso accident stands out as most important from the standpoint of risk regulation in Europe. [At Seveso in northern Italy gasses, including Dioxin, that escaped from a chemical plant contaminated fields, killed animals and injured people for two weeks before local authorities understood the full extent of hazard and ordered a temporary evacuation of the area around the plant.] …

More generally, the 1970s were a period in which a number of European governments became sensitized to chemical hazards, partly because of disasters but partly also because of a climate that favored a certain amount of industrial regulation, especially with respect to safety at work. The starting point for regulation in many cases was the political debate after an accident in a given country, but accidents in other countries helped to keep the issue on the European agenda. … On the whole, the safety legislation enacted in Europe in this period consisted mainly of provisions in various nation states and not at the level of the European Community (EC). …

…Council Directive 82/501/EEC [generally known as the "Seveso Directive"] … was the first community law requiring environmental information to be provided and exchanged across national frontiers, both among governments and between governments and the public.[1]

The principal aims of the Directive were described in an EC brochure. The first is "to reduce the likelihood of a major accident by requiring industry to incorporate preventive measures into the design of a plant or a manufacturing process from the beginning." The second is "to ensure that if an accident occurs, it does not escalate into a disaster." The Directive requires chemical-plant managers to install control and safety measures and prepare emergency plans. Thus described, the aims of the Directive focus on risk management.

These objectives have been operationalized by information obligations. Industrialists are required to provide to the "competent authority" (that is, to designated national control bodies) [information] that they have identified major accident hazards, adopted appropriate safety measures, and provided the people

working on the site with information, training, and equipment to ensure their safety. As noted above, in many member countries these requirements were already in place, or partly in place, through legislation on health and safety at work or via licensing procedures. …

… The more innovative part of the Directive, however, is the obligation to provide information to other parties, most notably the public at risk. Under Article 8, member states are required to ensure that people likely to be affected by a major accident are informed, in an appropriate manner, o the safety measures and correct behavior to adopt in the event of an accident.[2] …

[The 1986 EC study of implementation of Seveso Directive information provision requirements] showed that the guidelines were indeed practicable, as evidenced by their almost complete implementation in the United Kingdom.[3] But it also became clear that countries diverged in their views of the adequacy of existing routes of information provision. Some adopted information policies that can only be characterized as passive. In the Federal Republic of Germany and the Netherlands, for instance, the types of information that should be available about possible impacts of industrial activity were already extensively regulated. In the course of implementing the Seveso Directive, these information requirements were further extended. However, the available information was only indirectly brought to public attention. When a license was filed, people were informed of this fact, which meant they could inform themselves using the available material if they so chose. In the Netherlands people could in principle freely look through the files of a plant, but in practice this material was not easily accessible: it was highly technical in character and often filled many file cabinets. Some measures were adopted to facilitate public access to licenses and their contents [after the rise of citizen environmental activism in the 1970s]. … Nevertheless, all the information generated during licensing was restricted to people who actively seek it. [In addition,] licensing in most countries is heavily geared toward regulating an activity as it starts and much less toward keeping hazard information up to date. Licensing information also is not adequate to inform people about the most effective precautionary or protective measures to adopt in the event of an accident. …

European legislation, in contrast to that in the United States, interprets the public's relation to information as a *need* to know rather than a *right* to know. The former implies a right of access only to that information which is needed for a specific purpose, such as self-protection. The latter suggests an open-ended right of access to all information. The right-to-know principle has generally been interpreted as more far-reaching than the need-to-know.

Indeed, during the second revision of the EC Directive, the point was made that information resulting from a right-to-know approach could well be insufficient for purposes of public safety. The insufficiency might arise not only from the fact that too little information was given, although that could and did happen in many cases, but also from the fact that too much information might be given in the wrong way. Unfiltered risk information is often too technical, not sufficiently geared toward the needs and capabilities of lay people, and too cumbersome and difficult to acquire. That is why the Dutch licensing authorities [where licensing requires a public hearing on the application] are obliged to provide a popular version of the licensing requirements in addition to the technical version. More importantly, the EC has explicitly stated that providing information on a right-to-know basis is insufficient, because people do not receive the information that they need to act upon. The Seveso Directive provides not only that people must receive all necessary emergency response information but also that they must be informed in such a way that they can understand the risks they run. If people only get highly technical information, the latter objective is not fulfilled. In the Netherlands, the need-to-know principle has been translated into an obligation to provide information with various amounts of detail to varying groups of people. In risk-communication campaigns,

simple information is provided door to door. The opportunities for acquiring additional information are indicated, and meetings are organized for those who wish to be further informed. For the really committed, the original licensing material and risk analyses are provided.

These attitudes and practices stand in sharp contrast with the presumptions underlying [the US Emergency Planning and Community Right-to-Know Act].[4] … U.S. law provides only for the disclosure of information, not for its transmission in usable form to the public at risk. In the U.S. framework, the task of interpreting information and mobilizing citizen action accordingly falls to organized public interest activists, such as [local] and national environmental groups. In the EC countries, where the state [that is, government and government agencies] plays a more actively protective role towards its citizens, not merely the provision of information but also its screening and repackaging are seen as appropriately the obligation of the state.

Notes:

1. Council Directive of 24 June 1982 on the Major Accident Hazards of Certain Industrial Activities, 82/501/EEC, *Official Journal of the European Communities* L230, 5 August 1982.

2. Article 8 provides that

> 1. Member States shall ensure that person liable to be affected by a major accident originating in a notified industrial activity within the meaning of Article 5 [which defined the types of industrial processes covered by the Directive] are informed in an appropriate manner of the safety measures and of the correct behavior to adopt in the event of an accident.
>
> 2. The Member States concerned shall at the same time make available to the other Member States concerned, as a basic for al necessary consultation within the framework of their bilateral relations, the same information as that which is disseminated to their own nationals.

3. Commission of the European Communities, *Chemical Risk Control in the European Community* (Brussels: Commission of the European Communities, 1987).

4. [added by MJ Peterson] Adopted as Title III of the Superfund Amendments and Reauthorization Act of 1987, it was known as “SARA Title III” or “Title III” until 1991. In that year the US Environmental Protection Agency began using “Emergency Planning and Community Right to Know Act” or “EPCRA” in its documents, reports and publications.

United States Policy on Information about Chemical Plant Hazards, 1987-

from Susan G. Hadden, "Citizen Participation in Environmental Policy Making" in Sheila Jasenoff ed, *Learning from Disaster: Risk Management after Bhopal* (Philadelphia: University of Pennsylvania Press, 1994), pp. 91-112.

The complex interplay between public access to information and participatory institutions is illustrated in the law passed as part of the United States response to the Bhopal accident. One part of the law, which has proved relatively ineffective, established new institutions intended to bring diverse interests together to develop community emergency-response plant. A different part of the law made available startling new information about environmental risks and has led to significant participatory activity. If the new institutions under the former part could be expanded to allow consideration of new the information provided under the latter, a very effective model for citizen participation might evolve.

I argue in this chapter that the lessons learned from Bhopal or any other disastrous event depend very strongly on the existing institutions and political context. Societies, like people, only learn when they are ready….

[During debates about responses to the Bhopal disaster] the Senate Environmental and Public Works Committee adopted a suggestion by Senator Frank Lautenberg of New Jersey that provisions of his Bhopal-inspired bill be incorporated into [the Superfund Amendments and Reauthorization Act]. Thus two different environmental issues, hazardous waste disposal and emergency response to toxic chemicals, became closely tied.

This linkage further complicated an already complex issue. Drawing on experiences in their own states or listening to demands from constituents, members of Congress developed four policy responses to Bhopal: emergency planning and response, emergency notification, right to know, and an emissions inventory. Requirements intended to address each of the four concerns were thrown into the statutory pot as the bill moved through its many committees…Given the complexity of Title III, it should come as no surprise that its multiple purposes were fulfilled with varying degrees of success. … The statute's absolute distinction between local emergency planning and the federal toxic release inventory (TRI) made it difficult for citizens to obtain all the information about a facility in one place.

Finally, the different actors implementing the law often had very different ideas of the true purpose of the right to know. Emergency-response professionals, who tended to dominate state and local Title III activities, saw the right to know more as an aid to their planning activities than as of direct relevance to citizens. Industry, too, focused on safety and, in response to TRI data, on reducing emissions, believing that the data were generally too technical for citizens. Many public interest groups, in contrast, saw in "right to know" an opportunity to change the power structure in the community, with data providing a hitherto unavailable basis for demonstrating how powerful industries were compromising the health and safety of ordinary citizens. These different perspectives underpinned the inconsistent orientations of the law itself, since each group had the ear of one or more Congressional staff during the long battle over SARA.

Section 313 of Title III requires manufacturing facilities to report their emissions of about 350 hazardous chemicals. … The data are entered, by law, into an electronic database, so that citizens and regulators can identify emissions problems by region, company, facility, or chemical. Publicized by the media and environmental groups, the data have stimulated considerable participation by citizens at every level of government.

… However in almost every case, already-organized environmental groups were needed as intermediaries to make the data usable. The services they performed included knowing what facts were available and how to acquire them; knowing how to use computerized data systems; knowing how to analyze the data and where to find relevant supplemental information; and mobilizing citizens or politicians to achieve desired results.

Without the aid of intermediary groups, even the electronic database created under Title III (called the Toxic Release Inventory, or TRI) is not entirely adequate to the task of providing access to date, because it is difficult to locate and not "user-friendly." Once citizens do acquire data through the TRI, they must interpret it, determine whether risks are a cause for concern, and, if they are, persuade manufacturers to reduce their emissions. Title III does not grant citizens access to the supplementary information needed to interpret the data, although EPA and many private groups are providing such assistance. In short, access to date is but the first step in a complex process of analysis, risk assessment, and mobilizing political participation. Title III concerns only the first step – a necessary one, to be sure, and one that was previously extremely difficult. A wide variety of public interest groups were poised to assist citizens in taking one or more of the later steps…. As public interest groups continued to acquire data, transform it into comprehensible form, and publicize it, four types of policy outcomes became feasible: new laws, emissions reductions, legal actions, and improved enforcement of other environmental laws.

With less than six years' experience in implementing SARA Title III, we can already abstract some important lessons. While information remains an essential component of political power, information alone does not empower the recipients. The nexus between data and action is not obvious to most people; of those who can see a relationship, many do not find an issue sufficiently salient or the cost of acting low enough to merit participation. Various supporting mechanisms are needed, including institutions through which people can act if they wish. Institutions themselves gain strength when people need, use, and act through them, even altering them to suit their purposes. Thus Local Emergency Preparedness Committees (LEPCs) provided an unusual opportunity for a wide range of interests to work together, but their focus on emergency response limited their utility to communities where a spill had recently occurred. Recently, people in some localities have begun to talk about extending the purview of the LEPC to environmental issues other than hazardous materials, a development that would surely increase their vitality and salience.

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Bhopal Plant Disaster
Appendix G: Assessing Responsibility: The Engineers and Scientists

by MJ Peterson
Revised March 3, 2008

Appendix Contents:

References used in this section:

Indian Law Institute, *Mass Disasters and International Liability: The Bhopal Case,* Bombay: N.M. Tripathi Private Ltd. 1986, pp. 1-10 and18-58.

Memorandum of Law in support of Union Carbide Corporation's Motion to Dismiss India's Complaint on grounds of *forum non conveniens*

Additional readings:

J.P. Gupta, "The Bhopal gas tragedy: Could it have happened in a developed country?" *Journal of Loss Prevention in the Process Industries* 15/1: 1-4 (2005). [Argues that industry mindsets conducive to ignoring dangers prevail everywhere]

B. Bowonder, S.S. Arvind, and T. Miyak. "Low probability-high consequence accidents: Application of systems theory for preventing hazardous failures," *Systems Research* 8/2: 5-58 (1991). [Suggest a method of identifying possible dangers in complicated production processes]

S. Kovoormisra, "A Multidimensional approach to crisis preparation for technical organizations: Some critical factors," *Technological Forecasting and Social Change* 48/2: 143-160. [Uses Bhopal as example in discussion of handling in-plant and outside-of-plant aspects of industrial accidents.]

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Contrasting Views of Responsibility for the Bhopal Disaster

Plaintiff's Claim and Defendant's Motion to Dismiss in Union of India v. Union Carbide Corporation United States District Court, Southern District of New York. April 1985

Full texts in – Indian Law Institute, *Mass Disasters and International Liability: The Bhopal Case,* Bombay: N.M. Tripathi Private Ltd. 1986, pp. 1-10 and18-58.

Union of India's Complaint

from General Allegations Applicable to All Counts

10. At all times material, Defendant, Union Carbide Corporation designed, constructed, owned, operated, managed, and controlled a chemical plant in the City of Bhopal, in the State of Madhya Pradesh, one of the states constituting the Union of India, through its subsidiary Union Carbide India Limited.

11. At all times material, Defendant, Union Carbide Corporation manufactured, processed, handled, and stored in its plant methyl isocyanate (hereafter "MIC"), a chemical used in the manufacture of agricultural pesticides produced and marketed by Union Carbide.

12. At all times material, Defendant Union Carbide knew that MIC is an extraordinarily reactive, toxic, volatile, flammable, and ultrahazardous chemical; that MIC is one of the most dangerous substances known to man; that MIC is easily contaminated and reacts to certain contaminants with explosive violence and speed; that exposure to even small concentrations of MIC poses an immediate danger to living beings and the environment; and that human exposure to MIC is known to cause, among other things, death, serious respiratory impairment, and eye and skin damage.

13. At all times material, Defendant Union Carbide knew or should have known that the long-term effects of human exposure to MIC were not well-documented, but the various medical literatures suggested that exposure could lead to genetic and carcinogenic consequences.

14. With such knowledge, Defendant Union Carbide undertook to design, construct, operate, manage, and control a plant which would be safe for the production, handling, and storage of MIC in the City of Bhopal, India. The design included, by way of example and not limitation, the following:

(a) Process flow diagrams;

(b) Process and instrument diagrams;

(c) Performance specification and materials of construction of all major and minor equipment;

(d) Performance specification of control systems, control schemes, and materials;

(e) Valve piping and materials of construction specifications:

(f) Design criteria and sketches of Union Carbide's Proprietary Equipment;

(g) Typical equipment arrangements and unit layout; and

(h) Description of special analytical instrumentation and laboratory quality control equipment.

15. Defendant Union Carbide warranted that the design was based upon the best manufacturing information available and that the drawings and design instructions were sufficiently detailed and complete so as to enable competent technical personnel detail, design, erect, commission, and operate the Bhopal plant.

16. Defendant Union Carbide trained technical personnel for its Bhopal plant at its production facilities in the United States, including Institute, West Virginia. In addition, defendant Union Carbide supervised the Bhopal plant with personnel from its United States facilities.

17. Defendant Union Carbide represented to the plaintiff that it was a pioneer in pesticide research and development, with extensive research facilities and trained and experienced personnel. Defendant Union Carbide further represented to the plaintiff that it would provide the Bhopal plant with the best and most up-to-date technical data and information in its possession for the manufacturing, processing, handling, and storage of MIC and that it would continually update this information.

Union Carbide's Rejoinder

Memorandum of Law in support of Union Carbide Corporation's Motion to Dismiss India's Complaint on grounds of *forum non conveniens*

<u>from Background and Prior Proceedings (notes omitted)</u>

This [complaint] arises out of the release of methyl isocyanate ("MIC") from a plant owned and operated by Union Carbide India Limited ("UCIL") in Bhopal, India on December 3, 1984….

UCIL was incorporated under the laws of India 50 years ago. It owns and operates fourteen plants in India which manufacture chemicals, plastics, pesticides, and dry cell batteries. Its shares are publicly traded in India.

The Bhopal plant was managed, operated, and maintained entirely by Indians in India. It was wholly financed by UCIL through local financing provided by Indian financial institutions controlled by the Union of India, which also approved the plans for the establishment and construction of the plant, its operations and the products to be manufactured. While it is more economical to import MIC from outside India, it was the Indian government that required its production locally. The Bhopal plant employed approximately 650 people, all Indians. The Indian government restricts employment of foreign nationals in India, and no Americans were employed at the plant at the time of the incident or for some years before. None of Union Carbide's directors are on the Board of Directors of UCIL. All UCIL employees and officers, including its Chairman and Managing Director, are Indian citizens and residents. The products manufactured in the Bhopal plant were never sold in the United States. They were sold only in India.

The Government of India regulates all business in India and it requires substantial equity ownership by Indians. While Union Carbide owns 50.9% of UCIL's stock, the remaining 49.1% is owned by Indian nationals and entities. A substantial amount of UCIL stock is owned by entities controlled by the Government of India.

The Indian State of Madhya Pradesh owns the property on which the plant is situated and leased the lands to UCIL for ninety-nine years for the purpose of building and operating the plant. The Governments of Madhya Pradesh and the Municipality of Bhopal permitted and encouraged the development of hutments [shantytowns] in the areas immediately surrounding the plant – the areas most severely affected by the release of MIC.

International Dimensions of Ethics Education in Science and Engineering
Case Study Series

Bhopal Plant Disaster
Appendix H: Assessing Responsibility: Technical Expertise and Managers

by MJ Peterson
Revised July, 2008

Appendix Contents:

References used in this section:

American Society of Mechanical Engineers Code of Ethics:
http://courses.cs.vt.edu/~cs3604/lib/WorldCodes/ASME.html

Ethics Committee of the Institute of Electrical and Electronics Engineers Code of Ethics, Dec. 2002: http://www.ieee.org/web/aboutus/ethics/dissent.xml

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ENGINEERS AND MANAGERS

MJ Peterson, 2008

Work in a Hierarchical Organization

Most engineers work in business firms or government agencies where they report to others – to managers in firms and to higher level officials (the public sector equivalent of managers) in government agencies. Except in highly decentralized firms or agencies or when the resource commitments of time, money, person-hours of work, and materials are minimal, it is the managers or higher level officials – not the engineers – who have the authority to approve spending, set work assignments, determine deadlines, and decide how to handle customer or client requests for engineering services or advice. The hierarchical organization of firms and government agencies has two implications for an engineer: 1) an engineer is expected to follow the manager's instructions relating to spending, work assignments, deadlines, and dealing with customers or clients, and 2) an engineer who has strong doubts about the feasibility, environmental impact, or safety of a design, production process, product, or project has to be able to express them in ways that the manager or higher official will understand and find persuasive enough to change the instructions in ways suggested by the engineer's analysis.

Business firms and government agencies adopt hierarchical structures because they are useful. Hierarchical organization is a very effective way of coordinating the activities of many people because it concentrates decisions about major commitments to a relatively small group of leaders who then instruct others about what to do. At the same time, however, using hierarchical organization has some features that can create serious problems. Most importantly, hierarchy permits separation between possession of technical knowledge relevant to ensuring safe and efficient operation and possession of authority to commit organizational resources to a particular course of conduct. The separation will be greatest when the manager concerned was not trained as an engineer; a manager who was an engineer earlier in her or his career has better appreciation of the technical knowledge and is generally (but occasionally not) conversant with the current state of engineering knowledge. An engineer dealing with manager trained in engineering will have an easier time conveying technical concerns and rationales; the most effective engineers are those who can also convey those concerns and rationales to managers without any engineering background.

In any work group people can slack off or channel energy to their own affairs rather than the job at hand. Even though we often think of hierarchical organizations as involving closer supervision, there are many opportunities for employees at all levels to do their jobs or use their positions in ways that serve their own personal interests rather than the company's or government agency's interests. For example, an engineer who reports to a non-engineer manager can loaf until a deadline looms and then quickly put something together that will impress that manager even if it is poor engineering work. A manager, whether trained as an engineer or having an M.B.A., can allow purchasing decisions to be determined by bribes rather than choosing the best product for the purpose at hand. Employees at any level can release psychological tension by verbal abuse of coworkers, though managers have greater scope for this kind of activity since verbal abuse of a hierarchical superior carries more risk of getting fired than verbal abuse of an equal or subordinate.

Most of the workplace tensions and difficulties caused by a manager's lack of technical knowledge or abuse of authority over other employees have no effect on clients, customers, or the general public. The design is adequate even if not the best possible; the physical goods produced work as expected; the

production process operates without incident. This is why society generally leaves firms and agencies to work out their internal problems on their own. Societies can do this because there are ample sources of pressures on firms and agencies to work well. When economic conditions are good and there are other jobs available, people unhappy with the internal functioning of their firm or agency are likely to quit for other jobs, taking their training and experience with them. A business firm unable to handle internal problems that slow down delivery or customer service will lose sales to competitors who can deliver well and on time. Though most government agencies do not have to compete for customers, persistent and serious internal dysfunctions will be noticed by outsiders and can trigger loss of the public, legislative, or political leadership respect that an agency needs to protect its budget and assignments from bureaucratic rivals.

Most of the time, engineers and managers work well together and agree that the designs, facilities, production processes, or products they create are safe and effective. Yet there are times when engineers disagree with their managers over matters affecting the health and safety of fellow employees, of persons who live near a factory, power generator, or other facility, or of the general public. In these situations, engineers will face a conflict between engineering ethics and the norms of firm or agency behavior. All engineering codes of ethics stipulate that engineers have a special duty to use their knowledge and skill to protect the health and safety of the public. The internal rules of business firms and government agencies stipulate that managers have a special obligation to protect the financial well-being and public reputation of the firm or agency. Addressing safety concerns may require allocations of time and resources that firm or agency managers do not believe they have, particularly if improving safety sufficiently requires re-doing or un-doing expensive design or construction work. When time is short and money is tight, managers are under considerable pressure to take shortcuts.

Engineering codes of ethics specify than an engineer should always start by trying to resolve a safety disagreement within the firm or agency where he or she works. Internal settlement might mean that the engineer persuades her or his immediate manager, or that manager's superior, that the danger is real and serious and the manager issues instructions and allocates resources needed to modify designs, fabrication of objects, or running of facilities to avoid the danger. Internal settlement might also mean that a manager (or, more likely, another engineer) persuades the worried engineer that the danger is not serious or is prevented or minimized by some other feature of the design, installation, or operating routines that the worried engineer did not consider when estimating the danger.

The Ethics Committee of the Institute of Electrical and Electronics Engineers (IEEE), one of the largest professional associations in the world with some 365,000 members in 150 countries, has issued a set of guidelines suggesting how engineers who have serious doubts about the safety or environmental consequences of some firm or agency activity should go about raising their concerns with management. The guidelines are a supplement to, not a part of, the IEEE Code of Ethics, but do provide useful advice for engineers preparing to express concerns to their managers. The most recent version, issued in December 2002, is available at on the internet [1] and makes four main points about how to raise concerns effectively:

1. "Establish a clear technical foundation."

[1] at http://www.ieee.org/web/aboutus/ethics/dissent.xml

> This means engineers should explain as clearly as possible the engineering reasons why there is good reason to be concerned about the design, plan, or proposed activity and back that conclusion with the best available technical knowledge.
>
> 2. "Keep your arguments on a high professional plane, as impersonal and objective as possible."
>
> No matter how strongly an engineer feels about the matter, prudence and courtesy to others requires avoiding any language that the manager could interpret as insulting or as calling his or her competence and good faith into question. Thus engineers should be careful to criticize to project, not the person or persons who proposed or approved it.
>
> 3. "Try to catch problems early and keep the argument at the lowest managerial level possible."
>
> This suggestion derives from the well-known fact that the earlier a problem is noticed, the easier it is to fix. Some people's egos may be strongly attached to the current form of the design or proposal, but the less organizational time and resources have been committed, the easier it is to get managers to authorize changes.
>
> 4. "Before going out on a limb, make sure the issue is sufficiently important."
>
> Notice that this guideline refers to "going out on a limb," that is, raising a point that an engineer knows others in the company or agency are reluctant to hear or handle. An early suggestion for an inexpensive change is not going to put an engineer out on a limb; waiting until later or having to suggest an expensive remedy is much more likely to do so. Because firms and organizations as a whole, and even teams or other work groups within the same organization, vary considerably in their receptivity to suggestions, engineers have to know their organization or workgroup well to be able to anticipate tell when they are actually out on a limb. When organizations or workgroups are resistant, their members are likely to regard anyone raising questions, no matter how early, as a pain. Yet an engineer can keep their respect if concerns relate to significant matters and are presented in the objective and impersonal way suggested by guideline #2.

Expressing Concerns outside the Organization

When a disagreement cannot be solved internally because neither the engineer nor the manager or managers persuade the other, engineers may think about "going public" by bringing the potential danger to the attention of persons outside the employing firm or agency. Engineering codes of ethics provide very limited guidance in these situations. For instance, Paragraph 1 of the IEEE Code of Ethics enjoins engineers

> to accept responsibility in making decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment.

Engineers all agree that this paragraph means an engineer has a duty to warn managers or higher officials about choices that would create unsafe or environmentally hazardous conditions. There is less agreement about whether it establishes an obligation to "go public" if managers or higher officials ignore the warnings.

Paragraph 9 of the IEEE Code contributes to the uncertainty by enjoining engineers

> to avoid injuring others, their property, reputation, or employment by false or malicious action.

It would be easy for an angry manager or higher official to use this against an engineer who went public, by claiming that the public disclosure was based on false information or malicious desire to harm the company's or agency's public reputation.

The IEEE Ethics Committee is aware of the dilemmas facing "whistle blowers" (as employees who go public with their concerns are popularly known). Its Position Paper on Ethical Conduct Awareness issued in November 2004 says:

> The Ethics and Member Conduct Committee emphasizes that IEEE is committed to being supportive of any member who acts to uphold the IEEE Code of Ethics. It recognizes that voicing concern about ethical violations could jeopardize a member's career opportunities. Nevertheless, the EMCC believes that by raising awareness of IEEE's strong stance on ethical conduct through this Position Paper, its members in industry, academia and elsewhere will be helped to carry out their professional responsibilities in a manner consistent with the highest traditions of IEEE.

The American Society of Mechanical Engineers, which has over 120,000 members in the USA and other countries also has a code of ethics[2]. It includes similar statements of obligation to promote human welfare and of duties to serve both the public and an employer in its Code of Ethics of Engineers:

> *The Fundamental Principles*
>
> Engineers uphold and advance the integrity, honor, and dignity of the Engineering profession by:
>
> I. using their knowledge and skill for the enhancement of human welfare;
> II. being honest and impartial, and serving with fidelity the public, their employers and clients;
> …

The balance between serving the public and serving the employer may be tipped more heavily in favor of the employer in a later section of the ASME Code:

> *The Fundamental Canons*
>
> 1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
> …
> 4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.

The usual meaning of the words "faithful agent or trustees" suggest a duty to act in the best interest of the firm or agency as the employer understands them. A manager or official upset about public discussion of internal disagreements might invoke canon 4 against an engineer who has communicated concern to anyone outside the firm or agency.

[2]available via http://courses.cs.vt.edu/~cs3604/lib/WorldCodes/ASME.html

The IEEE Ethics Committee has also considered the problems of going public and developed Guidelines for Engineers Dissenting on Ethical Grounds. [3] It clearly advises engineers to follow a sequence in expressing concerns, starting within their employing organization by going first to their immediate manager or supervisor. If concerns are not resolved with that immediate superior, the guidelines then recommend using the company's or agency's own internal processes:

> 5. Use organizational dispute resolution mechanisms
>
> Good organizations have procedures, not always formal, for resolving disputes. After having exhausted informal efforts to persuade your manager, then you must consider using these mechanisms. Since this will almost certainly damage relations with your manager, this step should be taken only after a careful review along the lines discussed in guidelines 1 and 2. If you have an ally higher up in the management chain, you might appeal to that person for advice and possibly to intervene as a mediator.

The guidelines emphasize the importance of keeping good records of your communications and supervisors' reactions. The caution against violating laws is a reminder that am engineer needs to avoid actions that look like taking of company property or records, disclosing proprietary information, or making statements about others that could be interpreted as slander or libel:

> 6. Keep records and collect paper
>
> As soon as you realize that you are getting into a situation that may become serious, you should initiate a log, recording, with times and dates, the various steps that you take (e.g., conversations, email messages, etc.) Keep copies of pertinent documents or computer files at home, or in the office of a trusted friend – to guard against the possibility of a sudden discharge and sealing off of your office. But be careful not to violate any laws!

The IEEE Guidelines acknowledge that internal conflict resolution procedures may not work and advise care in choosing how to appeal to outsiders in paragraph 9:

> If, after the failure of internal conflict resolution measures, you decide to take the matter outside the organization, whether or not you decide to resign, care must be taken in choosing where to go. In many cases, an obvious place is a cognizant regulatory or law enforcement agency. Other possibilities include members of governments (from one's own district or state, or the head of a relevant committee), or public interest organizations. Of course some combination of these might be chosen. Although it is usually not a good idea to take one's case directly to the news media, they generally become involved eventually, usually in reporting actions taken by whatever entity the engineer has contacted. One must take special pains to be accurate and clear when dealing with journalists so as to minimize sensationalism and distortion. When given a choice among media organizations, choose those with reputations for fairness and accuracy.

[3] The most recent version, adopted in December 2002, is available at http://www.ieee.org/web/aboutus/ethics/dissent.xml

"Going public" is a tough choice because, as the IEEE Guidelines acknowledge, it is difficult to remain in the firm or agency afterward. Some people deal with that by resigning their position before going public. This is a serious action requiring careful consideration, particularly for engineers who have dependents. As the Guidelines note in paragraph 7:

> One obvious choice is to resign. The advantages are: (1) This adds credibility to your position--makes it obvious you are a serious person. (2) Arguments that you are being disloyal to your employer are disarmed. (3) Since you are likely to be fired, resigning may look better on your record.
>
> The drawbacks are: (1) Once you are gone, it may be easier for the organization to ignore the issues you raised, as others in the organization may be unwilling to carry on the fight. (2) The right to dissent from within the organization may be one of the points you wish to make. (3) You might thereby lose pension rights, unemployment compensation, and the right to sue for improper discharge.
>
> It would be wise to consult an attorney before making this decision.

Someone unable to resign might consider making an anonymous report to a regulatory agency, a law enforcement agency, or a reporter. Yet this also has problems, as noted in paragraph 8:

> One problem is that an anonymous report may not be taken seriously. Providing enough information to make the report more credible may make it easy for the organization to identify its source. Being exposed as a purveyor of an anonymous report may be even more damaging to the engineer than the effect of openly making the report would have been. A reporter might distort the facts to make the case more "newsworthy". Nevertheless, this route is sometimes taken in preference to doing nothing at all. In such a case, one should be particularly careful not to malign any individuals and one should convey in the [anonymous report enough information to enable the recipient to verify] the claims made.

Whistleblowers are usually isolated within their employing firm or agency, and many find that "going public" effectively ends their professional careers because other firms and agencies are reluctant to employ them. Yet whistleblowers do have supporters. One of the larger and more prominent organizations involved is the Government Accountability Project, a private association based in the USA. On its homepage [4] it describes itself as "a 30-year-old nonprofit public interest group that promotes government and corporate accountability by advancing occupational free speech, defending whistleblowers, and empowering citizen activists."

Public opinion may or may not support whistleblowers. In Western democracies they are typically viewed positively, particularly if the company or agency is a large one and the conflict can be presented as the story of a brave and conscientious individual facing an uncaring colossus. A whistleblower will also have an easier time gaining and keeping support if the public's perception of the company or agency involved is already unfavorable because of past problems or incidents. Public sympathy can dissolve very quickly, however, if the whistleblower comes across as arrogant, vengeful, or unwilling to consider anyone else's views of the matter.

[4] www.whistleblower.org