Appendix B: Stakeholders and Level of Responsibility

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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.]

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This case should be cited as: M.J. Peterson. 2008. "Bhopal Plant Disaster." International Dimensions of Ethics Education in Science and Engineering. Available www.umass.edu/sts/ethics.

Sanjoy Hazarika, *Bhopal: The Lessons of a Tragedy* (New Delhi: Penguin Books India Pvt Ltd, 1987) [summary of events leading to 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 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 minimize 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									

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