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The chemical industry consists of more than 12,000 manufacturing plants in the U.S., producing a total of more than 66,000 different commonly- used chemicals.[1,pg.III-6]

During the past 30 years, individual chemical plants have grown larger- -often increasing 10-fold in size--to take advantage of economies of scale. A chemical plant today will typically produce 300,000 to 600,000 metric tonnes (660 million to 1.3 billion pounds) of product per year. Storage tanks at a plant may hold as much as 1.5 million barrels (75 million gallons) of product or raw material.

Chemical plants are complex, tightly-coupled operations. Tightly-coupled means one event or process affects another event or process directly and quickly, thus making human intervention difficult when something goes wrong. Complex means that events cannot be predicted reliably because many different things can go wrong in many different ways. This is why every chemical plant in the world is an accident waiting to happen.

During the last 30 years, while plants have grown larger, many corporate managers have adopted policies that increase the chance of an accident:

** The spacing of process equipment within plants has been reduced, to save money on energy, piping, and instrumentation.

** During the 1980s, faced with the worst recession in 50 years, the chemical industry laid off thousands of workers, thus reducing the numbers of knowledgeable people paying attention to various processes.

** In order to diminish the power of labor unions, petrochemical corporations in the 1980s began replacing regular employees with contract laborers, temporary workers who move from site to site, rarely gaining in-depth experience. According to Nicholas Ashford at MIT [Massachusetts Institute of Technology], "well over 30%" of the hours worked in the petrochemical industry are now logged by contract employees. Contract employees lack the process-specific experience of many of the workers they have replaced.

** Meanwhile in recent years, chemical plants have been run, in some cases, in excess of 100% of their "official" capacities.[1,pg.III-8]

** Finally, in some instances, it is obvious even to an outsider that corporate owners are letting their plants decay. You need only to drive along the Niagara River in Niagara Falls, N.Y., to see fully-operating plants that are not being maintained, or repaired properly, or even painted, as they rust, decay and deteriorate with time.

As you might expect, there is evidence that the frequency of chemical accidents has increased in recent years. According to Nicholas Ashford, a survey of the largest property losses over the past 30 years indicates a five-fold increase in the average loss (calculated in constant dollars, taking inflation into account). A study by the Organization for Economic Cooperation and Development (OECD) notes that, in the post-World War II period, the incidence of major industrial accidents was only one every 5 years or so, until 1980. Since 1980, the incidence has risen to two major accidents per year. Thus, according to the OECD, the frequency of major chemical accidents has increased 10-fold in recent years.[1,pg.III-9]

However, it is not major accidents that affect the largest number of people. It is the smaller, more routine accidents that expose workers, emergency response personnel, the general public, wildlife, soil and water to toxic chemicals.

When a reporter sets out to examine routine chemical accidents, he or she quickly learns that there are no reliable data. Three databases are nationwide in scope and contain information on toxic chemical accidents, but each database is flawed in some major way. The federal Bureau of Labor Statistics (BLS), for example, maintains records of worker accidents--but they omit injuries to contract workers who, as we have seen, represent at least 30% of the total workforce in the chemical industry. (Injuries to petrochemical contract workers are reported under various categories in the construction industries.) Since contract workers are more accident-prone than regular employees who have learned the ropes during years spent at a plant, the BLS database substantially under-reports workplace injuries in petrochemical plants.

The other databases suffer from flaws that are similar or worse.

The National Environmental Law Center (NELC) examined one of the national accident databases for the period 1988-1992. They studied the Emergency Response and Notification System [ERNS] database, maintained by EPA [U.S. Environmental Protection Agency].

The NELC staff did not summarize the entire ERNS database; for example, they only gathered data on about 800 out of 66,000 chemicals commonly in use. Furthermore, they omitted data on accidents involving only petroleum products (fuel oil, gasoline and so forth)--which means they omitted 52% of the ERNS data.

Still, what they found is impressively large. NELC reports that during the 5-year period, 34,500 accidents involving toxic chemicals were reported to ERNS; this means that, on average, a toxic chemical accident was reported 19 times per day in the U.S., or nearly once every hour.[2,pg.1]

To get an idea of how badly the ERNS database may underestimate the chemical accident picture, its data can be compared to a more thorough study conducted by the Attorney General's office in New York state.[3] The New York study examined records from EPA, the New York Department of Conservation, the U.S. Coast Guard, the New York Office of Fire Prevention and Control, and a private newsletter.

The New York study found that a total of 3496 toxic chemical accidents occurred in New York state during the 3-year period, 1988-1990. During this same 3-year period, only 496 New York accidents were reported to the ERNS database. If this kind of under-reporting is typical of the ERNS database, then the true picture of chemical accidents in the U.S. may approach 240,000 chemical accidents per year, or 130 per day, or 5 per hour around the clock.

Despite astonishingly poor data, it seems safe to say that chemical accidents are a large, and probably growing, problem. Nicholas Ashford at MIT has described a fundamental solution, which he calls primary prevention. Primary prevention means designing chemical processes to eliminate the possibility of an accident; secondary prevention reduces the probability of an accident.[1,pg.III-1]

The bulk of Ashford's report (which was funded by EPA) describes how industry might change from its present emphasis on secondary prevention (add-on safety systems, such as sprinklers, leak detectors and double- walled tanks) to an emphasis on primary prevention (designing plants so they rely less on toxic, volatile, flammable, or reactive chemicals, and so they operate at reduced temperatures and pressures).

Ashford finds that technology-forcing regulations can help, i.e., regulations that require industry to do things that they say they cannot do today. Ashford finds that the chemical industry has a decent record for innovating when the law says it must.

Toxic tort (injury) lawsuits can be another beneficial force,

prompting industry to innovate, Ashford says.

Government enforcement of worker safety laws is presently NOT an effective inducement for industry to change its ways, Ashford finds. Regulatory fines for OSHA [Occupational Safety and Health Act] violations averaged only $75 per violation during the period 1970-1980 and then dropped even lower during the Reagan years. The median OSHA fine following a death or serious injury accident in 1990 was only $890 (less than half what it had been in 1972, after the figures are adjusted for inflation).[1,pg.VI-1] Thus, at present, it appears to be cheaper to kill and injure people than to make chemical plants inherently safer.

Some argue that corporations, as presently structured, simply cannot do the right thing. For example, when Union Carbide killed somewhere between 3000 and 8000 citizens of Bhopal, India in 1984 and injured somewhere between 200,000 and 600,000 others, they aggressively resisted demands for compensation. They ultimately paid $520 million total ($470 million to the victims, plus $50 million to Carbide's lawyers). Just the economic damage from the event (leaving aside the question of fair compensation to the victims) was estimated to be $4.1 billion, so Carbide got off incredibly lightly. Carbide said it accepted "moral responsibility" for the catastrophe at Bhopal, yet it refused to pay the real dollar costs.

Given the legal structure of corporations, Carbide had no choice, says Ward Morehouse: "Had they been genuinely forthcoming and made truly disinterested offers of help on a scale appropriate to the magnitude of the disaster, they would almost certainly have been confronted with suits by shareholders seeking to hold the management accountable for mishandling company funds...."[4,pg.490]

Furthermore, the stock market sends perverse signals to corporations that create disasters. The day the $470 million penalty against Carbide was announced, its stock rose $2.00 per share.[4,pg.487] Last week when a jury awarded $5 billion to victims of the Exxon Valdez oil spill, Exxon's stock rose $1.50 per share.[5]

Whatever the solution to these problems turns out to be, the nation will need more reliable data on chemical accidents. The Clean Air Act of 1990 created a Chemical Safety and Hazard Identification Board, charged with "investigating the causes of chemical accidents, issuing reports to Congress and other federal and state agencies, and proposing ways to reduce the risk of injuries arising from the production and use of chemicals."

Unfortunately, at present the Board has no effective budget, so the very substantial benefits that it could provide may be lost unless Congress takes action soon to give the Board the resources it requires.

--Peter Montague

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[1] Nicholas A. Ashford and others, THE ENCOURAGEMENT OF TECHNOLOGICAL CHANGE FOR PREVENTING CHEMICAL ACCIDENTS: MOVING FIRMS FROM SECONDARY PREVENTION AND MITIGATION TO PRIMARY PREVENTION (Cambridge, Mass.: Massachusetts Institute of Technology, 1993). This insightful and even- handed report is available free from the federal government's EPCRA hotline (1-800-535-0202); request "The Ashford Report"; expect delivery in 2-3 weeks.

[2] Joel A. Tickner and Hillel Gray, ACCIDENTS DO HAPPEN (Boston, Mass.: National Environmental Law Center [29 Temple Place, Boston, MA 02111; phone: (617) 422-0880], August 1994.

[3] Peter N. Skinner, TOXIC CHEMICAL ACCIDENTS IN NEW YORK STATE 1990 DATA SUMMARY (Albany, N.Y.: Environmental Protection Bureau, New York State Department of Law, 1991).

[4] Ward Morehouse, "The Ethics of Industrial Disasters in a Transnational World: The Elusive Quest for Justice and Accountability in Bhopal," ALTERNATIVES Vol. 18 (1993), pg. 487.

[5] Keith Schneider, "Exxon is Ordered to Pay $5 Billion for Alaska Spill," NEW YORK TIMES September 17, 1994, pgs. A1, A10.

Descriptor terms: chemical industry; accidents; spills; leaks; occupational safety and health; job safety; nicholas ashford; mit; oecd; bureau of labor statistics; national environmental law center; emergency response and notification system; epa; studies; databases; primary prevention; regulation; toxic torts litigation; osha; chemical safety and hazard identification board; union carbide; bhopal; fines; exxon valdez; oil spills; corporations;