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Insuring and Managing Hazardous Risks: From Seveso to Bhopal and Beyond

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Insuring and Managing Hazardous Risks: From Seveso to Bhopal and Beyond

An executive report* on an international conference at IIASA and an overview of the conference proceedings

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PREFACE

This executive review describes in brief the International Conference on Transportation, Storage, and Disposal of Hazardous Materials, held at the International Institute for Applied Systems Analysis (IIASA), and the ensuing Proceedings, ***Insuring and Managing Hazardous Risks***. The Conference brought together representatives of academia, business, and government from East and West to discuss the nature of current problems in the area of hazardous materials. An important objective of the Conference was to suggest steps that could be undertaken by industrial firms, the insurance industry, and government agencies to improve the safety and efficiency with which hazardous materials are produced and controlled in industrialized societies.

Conference sponsors were the International Institute for Applied Systems Analysis (IIASA), The Geneva Association, and the Center for Risk and Decision Processes of the University of Pennsylvania. Additional financial support was received from the US Environmental Protection Agency, the Monsanto Corporation, the Rohn and Haas Corporation, the Center for Organizational Innovation and the Reginald Jones Center at the University of Pennsylvania, and the Canadian

Committee for IIASA. We are grateful to all of these institutions for their generous support of the Conference.

Within IIASA, a long history of research in risk activities is evident. This owes much to the vision of IIASA's founding Director, Howard Raiffa, and to Program Leaders who have promoted risk research at IIASA. The Conference continued this tradition with the strong support of IIASA's Director Thomas H. Lee and Deputy Director Vitali Kaftanov.

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INTRODUCTION

Despite having advanced three decades into the age of nuclear power, we still face the problem of the disposal of hazardous wastes. Hazardous materials are used to produce goods and services that people desire, so there is no question of doing without them.

But using them has led to industrial accidents, sometimes spectacular disasters: leakage of methyl isocyanate from a Union Carbide plant in Bhopal, India, killed 2500 people, caused eye injuries to 34 000 others, and caused 200 000 people to leave the area when the plant was recommissioned. Natural gas explosions at a Pemex plant in Mexico killed 452 people, left 31 000 homeless, and forced the evacuation of 300 000 others. In Mississauga, Canada, 220 000 people were evacuated when a trainload of chlorine was derailed. An estimated 15 000 people died when the Marvi-Macchu dam, in India, gave way. The cost of decontaminating a hazardous-waste dump in Colorado has exceeded $500 million, and another dump in Times Beach, MO, has cost $235 million. At Seveso, Italy, 250 000 m^3 of contaminated soil had to be buried, rendering many acres of land unusable and forcing people from their homes. One lesson we have learned from these disasters is that we cannot anticipate what form the next catastrophe will take in terms of death, dislocation, and financial equity.

We have witnessed the rise of environmental concerns during the past 15 years. So the public, understandably, insists on protection of its health and safety and wants to be handsomely compensated in case of accidents. In many cases the courts have agreed, with the word *accident* often being redefined – from a sudden calamity with a specific origin to an emergent problem the cause of which cannot be located in time or attributed to one source.

For insurers, the result is massive uncertainty: What are they liable for? How have they assumed risks that may not have been conceived when the underwriting occurred? How can they determine their premiums for the future if risk levels can be established only inferentially from limited historical samples? How can they calculate their exposure if past experience is no longer a reliable guide and if the legal rules are changed in the middle of the game? How can they keep losses from attaining staggering sums?

Manufacturers have their problems as well. If insurance is too expensive, they may be forced to risk operating with limited or no coverage, in which case victims of accidents may receive only limited compensation for injuries and losses. Some firms might be forced out of business for environmental reasons, but actually be essential for economic, social, or other reasons. Firms may have incentives to invest in safety and thereby reduce their liability – but how can they determine the optimal level of protection?

Despite these problems, which arise from many perspectives, there are risk-management tools – insurance, compensation, and regulation – that together may help us deal with hazardous wastes and their consequences. These tools must be used not as "quick fixes", however, but as elements in a system, including the production process where waste is generated, the means by which it is transported, and the means by which it is disposed of or stored. The interested parties – manufacturers, insurers, government agencies, the general public, as well as potential victims of accidents – are not isolated from each other.

The concern of this Conference focused on the role of the risk-management tools of insurance, compensation, and regulation in those parts of the process where they can be used imaginatively to manage hazardous materials from cradle to grave. The following synopsis serves as an introduction to the Conference Proceedings, *Insuring and Managing Hazardous Risks*.

PURCHASING THE PROCEEDINGS

The book *Insuring and Managing Hazardous Risks: From Seveso to Bhopal and Beyond* will be published by Springer-Verlag in the early fall of 1986. Copies of the book will be available through your local bookseller or directly from Springer-Verlag, Tiergartenstrasse 17, D-6900 Heidelberg 1, FRG or Springer-Verlag, New York, Inc., 175 Fifth Avenue, New York, NY 10010, USA.

THE INSURANCE DILEMMA

WHY INSURANCE?

Although insurance can never substitute for preventive measures to protect people and the environment, it can soften the economic impact of random harmful events. Whatever measures are taken, risk is always present. Risk is defined in terms of an event whose occurrence is of definite duration and beyond the control of any party – an "accident". It applies to a known number of victims.

The point of obtaining insurance is to transform unsure financial burdens from unforeseen events into well-defined and limited costs within a known period of time, so that the insured parties can eliminate or reduce the imponderables on their books. Insurers desire to reduce their imponderables as well, so they must be able to assess future losses and spread the risks as widely as possible. The language of the policies must be exact, the terms precise.

UNCERTAINTIES INTRODUCED BY HAZARDOUS MATERIALS

Hazardous materials have changed the notion of "accident". Claims are currently made on policies written as long as 50 years ago and are filled by people who may have been located far from the area of the incident. Insurers can no longer always define the event that triggers the claims or easily trace the course from the polluter to the injury. Losses can reach catastrophic proportions and are often not limited to actual damage. They may apply to a wide range of consequences, from the loss of use of contaminated plants to environmental impacts, such as foul odors. New technology may produce previously unsuspected toxic effects; materials that are safe individually may be toxic when taken in combination. Sometimes risks are revealed that could not have been conceived when the underwriting occurred.

There are other uncertainties as well: high punitive damages and cleanup expenses (which insurers formerly covered in order to prevent or minimize liability claims). All in all, insurers are attempting to make sound calculations of premiums in unaccustomed, uncertain circumstances.

LIABILITIES OF THE LIABILITY SYSTEM

Legal decisions have changed the rules that determine who is liable to whom under what circumstances, so that new legal rules favor injured claimants. (The US, where reliance on liability insurance is greater, has been affected more than Europe, where there is comprehensive national health insurance.) The rules have changed because of previous widespread dissatisfaction with the liability system, a system that is not fully to blame since it was not designed to deal with all of the issues raised by hazardous materials.

Legislators may determine the limits, if any, of liability, but insurers cannot provide unlimited coverage for high-exposure risks. They must be able to calculate

their exposure before the fact. For instance, there are no reserves to cover the extensive costs of cleaning-up sites, since this was not a risk considered when many of the earlier policies were written; present policyholders will have to make up the loss.

Liability insurance will not become obsolete: it will merely be relegated to areas where causation and blame can be conventionally fixed. Even though insurers presumably could protect themselves by increasing premiums and limiting coverage, they have taken steps to reverse the trends toward expanded liability. They are concerned that the courts will expand coverage retroactively. Injured people still have the right to sue under tort law, a procedure that is encouraged since compensation through special funds is limited.

In response, American insurers have changed to "claims-made" coverage, under which claims can be brought only as long as the coverage is in force. Claims-made policies are necessary until losses can be reliably projected. To be an effective solution, they depend on a common understanding between insurers and insured parties, both of whom must honor each other's interests. Such policies can also be abused: insurers may cancel policies arbitrarily and insured parties may try to precipitate claims (and the courts will tend to favor them). Licensing and other regulatory controls become, in effect, nonenforceable if policies must be renewed for many years after the industrial activity they cover has ended.

CONTRIBUTORY ISSUES

Insurers cannot easily mobilize their capacity for coverage because they are a diverse, independent group. This trait fosters competition among them – indeed, the insurance market swings between periods of plentiful and inexpensive coverage to periods of restrictive policies with high premiums. Competition also makes insurers more than reluctant to pool their resources or adopt a uniform approach to underwriting. Yet they have joined into pools to provide coverage for nuclear

power, since governments have required insurance for nuclear liability and have provided limited backup guarantees. These lessons might be applied to environmental risks.

THE NEED FOR FLEXIBILITY

If the insurance industry does not respond to a need for coverage, then mutual insurance organizations may spring up, or the government may have to intervene.

Insurers must define their terms with clarity, especially regarding what is and is not covered – for instance, explicitly canceling coverage if the insured violates applicable laws or regulations designed to protect the environment. Even in cases of clearly written clauses, however, the courts have tended to favor the insured; Congress has indicated that it will help insurers establish rules governing the interpretation of words or clauses.

Insurers must be able to revise their premiums in response to new developments in technology, science, medicine, economy, or law. Underwriters must strive for a point of "determinateness" – when they can close their books and reevaluate their policies and correct, if necessary, their underwriting practices. Insurers will also have to reexamine the "polluter pays" principle and the "cradle-to-grave" rules of liability.

To increase the scope of available coverage, the principles of all-risk, first-party insurance must prevail. The costs of pollution could be allocated according to the evidence of causation – that is, collectively and not individually. All injured parties would be compensated fully and the cost of the benefits would be assigned to the polluters as a group. This plan might avoid the problems of unclear or multiple causation.

THE OUTLOOK

Insurance coverage for hazardous materials will have its price, but it will not provide long-term security.

Rather, the insured amounts will be fairly modest, compared with the potential of some catastrophes. Insurers will provide coverage only for claims made within a specified period and will not cover the cost of cleanup of the insured's own premises. Policies will exclude specific substances by name (for instance, asbestos) or specific types of damage (for example, genetic). Insurers will be selective and avoid high-risk facilities.

For long-term risk, coverage should utilize techniques borrowed from life insurance. Its continuity must be assured, perhaps with such sweeteners as savings on premiums when claims are lower than expected. Political factors may also inhibit new directions, so alternative systems of insurance may be difficult to develop. The role of private insurers depends on their willingness to meet the demand and cooperate with government in developing a satisfactory system.

THE DEVELOPMENT OF ENVIRONMENTAL-IMPAIRMENT LIABILITY (EIL)

Despite billion-dollar claims for environmental catastrophes, aggregate losses from these disasters are low, even negligible, compared to, say, losses from all fires. Why, then, do insurers make a fuss about EIL?

Several reasons account for their concern. Only a few policies are issued, so that the premiums collected are small relative to the possible catastrophic losses. In addition, familiar events, such as fires, are not viewed by the public as threatening to its health, but the smallest pollution case is viewed with high emotions, which quickly can turn the problem into a political issue. Other parties, from lawyers to cleanup contractors, see the EIL insurer as a "deep pocket" that can be picked endlessly.

EIL, which began in 1974, today issues claims-made policies. Although insurance rates normally depend on the size and frequency of claims, too little is known about the conditions covered by EIL for this insurance to rely on past history. A more subjective approach is thus used. Processes and substances are listed

according to their chance of causing harm (without considering whether a claim might arise or the extent of such a claim). Among other elements considered are the country involved, its history and degree of technical development, the claims-consciousness of its people, the legal system, and the stability of the prospective client's company.

The client's premises are inspected to assess the possibility of actionable claims. Hazards are identified and then quantified according to several models (for instance, emission of toxic substances or heat radiation or vapor-cloud explosion). Plant managers are urged to eliminate or reduce as many risks as possible. Despite these preventive actions, corporations are concerned that their insurance is adequate to cover a catastrophic loss. Today, EIL has practically dried up in the US and the premiums have skyrocketed for the limited coverage that a firm may possibly be able to purchase.

Several participants at the conference pointed out that EIL coverage available worldwide has been drastically reduced since 1983; currently, individual coverage limits for a single firm are of the order of $10–20 million – hardly adequate for the risks involved. The US has been particularly hard-hit because of a lack of reinsurance, a reflection by reinsurers of their view of the American courts and the extraordinarily large settlements in recent years.

The EIL system would benefit from better organization. Reinsurers are too far removed to be directly involved in the investigation and settlement of losses. Underwriters, loss adjusters, and risk engineers must work together more than they have in the past. National and international reinsurance pools need to be formed and techniques for handling claims and losses must improve in order to both satisfy the victims and keep losses within acceptable proportions.

REEXAMINING COMPENSATION

A NEW LOOK AT STATISTICS

Today, the cost of environmental damage appears to be prohibitively high to insure. In fact, the total financial burden of this damage is not a large proportion of the burden of all environmental accidents.

Interesting figures appear when we look at disasters that involve deaths, large-scale evacuation, or expensive cleanup (for instance, oil spills, tanker accidents, decontamination of hazardous-waste dumps, dam accidents, contamination of soil or water, air pollution, noise, and radioactivity. With few exceptions, they have never caused third-party damage greater than that which has occurred in airline crashes, industrial fires, or explosions. Other forms of losses may well exceed this amount, so the premium for third-party liability coverage can be expected to be only a modest proportion of the total premium.

A statistical "law" seems to be operative: the frequency of accidents diminishes in proportion to their severity, and the financial weight of technological disasters in different categories of severity stays roughly constant. (The law does not seem to apply to

catastrophic natural disasters.) In particular, accidents causing losses greater than $20 million give rise to aggregate losses that amount to less than those of 25% of all accidents. Accordingly, insurance and compensation for such accidents is not, *prima facie*, constrained by aggregate economic losses, nor do such accidents lie outside the normal domain of insurability.

The problems noted earlier with EIL insurance are even more striking when contrasted with these statistics. To date, the total cost has been a small fraction of the cost of preventive measures. Finally, the total cost of pollution disasters is much smaller than that of natural disasters, at least in industrialized countries. Some form of compensation to potential victims of pollution damage, therefore, is not an unreasonable aim.

HOW COMPENSATION CAN BE STRUCTURED

In order to make sure that victims of serious pollution accidents are compensated, insurance has been required for firms that produce hazardous waste as by-products, compensation funds have been established, and parent companies have been made liable for their subsidiaries. These strictures have created problems for firms that are too small to self-insure and have found liability insurance too costly or impossible to purchase. Since no insurance system can cover the very rarest and most costly events, compensation ceilings will be necessary, although they will be higher when the risk is more widely spread.

Some disasters – radioactivity, oil slicks, discharges of dangerous waste, air pollution, and noise, for example – can cause catastrophic losses, so some governments have established special compensation systems to protect industries from going under and victims from being poorly compensated. These are designed to pay larger sums rapidly without attributing fault to any particular party. The governments normally levy a tax on firms to create these special funds and may have to utilize revenue from other sources to cover losses above the existing compensation ceilings.

ASSESSING RISK ASSESSMENT

THE LIMITATIONS

Practitioners do not fully understand scientific risk assessment and experts disagree over both the terminology and the techniques used. The differences are less in the models than in the assumptions behind them and the judgments made from them. For instance, are mice good subjects from which to draw inferences about human risk to toxic substances? Even if the answer is no, are the data derived from animal tests valid enough to help the public make decisions? Uncertainty and subjectivity, however, need not imply chaos. We can always try to bias results upward, so that the "true" risk is unlikely to exceed the estimate we reach.

People have difficulty assessing risk, partly because of difficulties in understanding past events and partly from fantasizing the future. They tend to overestimate risks from sensational causes of death and underestimate those from nondramatic ones (partly because the news media have the same bias). Even accurate information can raise worries. Anxious people also tend to deny the uncertainty – thus making the risk so small that it can be safely ignored or so large that it should clearly be avoided.

People want facts, not probabilities. They do not want to face gambles, a form of denial that accounts for the polarized attitudes toward such hazards as nuclear power or pesticides. Polarized attitudes are harder to change, even with new disproving evidence; yet those without strong opinions can easily be swayed by the way information is presented. The potential for manipulation raises its own ethical questions.

THE PROSPECTS

People can, nonetheless, be educated about risks – if they and the experts share an atmosphere of trust.

Risks described quantitatively can be shaped by the way the hazard category is defined, what consequences are measured or reported, and the unit of observation. No statistical display can guarantee that a risk will be understood, but comparisons between two figures have been shown to be more meaningful than absolute numbers or probabilities. Comparisons can also act as guides to decision making, although the public needs other information as well, such as the costs and benefits of the available options and the degree of uncertainty in the assessments.

Communication problems extend beyond numbers. "Risk" may not mean the same thing to the public as it does to the experts, even when it is quantifiable and predictable. Lay people worry more about hazards, the adverse effects of which are uncontrollable, dreaded, catastrophic, or fatal rather than about risks that are injurious, not offset by compensating benefits, and latent (i.e., future generations must bear them). They are more concerned over a small accident in an unfamiliar system (e.g., in a nuclear reactor or a recombinant-DNA laboratory) than a large one in a familiar system (e.g., a train wreck).

Consequently, these attributes must be considered along with probabilities and potential losses. Risk assessors must remember that the broader concerns reflected by the public are legitimate. In a sense, each hazard is unique, but in an attempt to understand the

collective lay mind, multiattitude indices are being compiled and studied.

Future research in risk assessment appears most promising. One aspect is informed consent, which permits people to make decisions in their best interest. Current procedures of informed consent convey the probabilities of risk better than the consequences: How can a deeper perspective about the latter be conveyed? Perhaps victims of a problem (a disease, for instance) should inform the public about its physical and emotional impact. We know virtually nothing about how strong a tendency there is to deny the relevance of a risk or about the nature of the process of assimilating a message.

Another area of research is developing creative indices and analogies. We might study the way people understand commonly used measures for distance, time, and speed, or how they react to specific figures on a scale such as the Richter scale, designed to measure earthquakes. Perceptions are malleable, so we must learn how people organize the data. Does, for example, presenting information in more than one way help or confuse the listener? Since information cannot be presented neutrally, we must be aware of ethical and political implications of different modes of displaying data. We must remember to test all messages, recognizing that they may be informative in different ways.

Other research is required on how individuals characterize risk and how they differ in representing it. We also need to know whether people can absorb information as index summaries and whether they will make or accept decisions based on these.

HELPING OUT THE MEDIA

The media have been criticized for misleading the public, not only by the content of stories, but also by the massive attention bestowed upon some issues; quantity both shapes and defines issues. Stories rarely include "enabling information" that tells readers or listeners where to obtain help or further details.

In defense of the media, risk stories are inherently complex and journalists must depend on experts in many fields. Scientists can help them by discussing their findings with them, providing as complete and unbiased information as possible, and developing clearinghouses for scientific news.

Research should study the theory of media – why, for instance, is disorder prime news (one reason is that it threatens values) – or issues that serious journalists may find useful – for instance, systematic biases or inadequacies in stories where the experts disagree.

THE DYNAMICS OF CRISES

WHEN STRUCTURES FALL APART

A crisis can be likened to an unfurling wave because it is not an ordered series of decomposable difficulties, but a complete breakdown – technical, organizational, and psychological. Existing policies and programs no longer work because they are designed to cope with normal situations rather than unexpected ones.

Organizationally, a crisis turns sequences into rapid chain reactions. Underlying antagonisms surface when a number of contradictory requirements must be met at once. People look for the technical miracle – or undertake witch hunts in search of scapegoats. This disorder feeds on itself, so corrective mechanisms cease to work. Potential sources of help retreat, viewing the crisis as a threat to themselves. Teams disintegrate, leaving individuals to face problems on their own: communication falters, trust evaporates. A crisis exposes vulnerable points in the overall sociopolitical fabric.

RIGHTING THE WORLD

One can, however, cope with a crisis. Much of the response is tactical: speed is essential. Basic

arrangements must converge – trained teams of specialists knowledgeable about the hazards of industrial products, communications and advice centers (for instance, the chemical industry's CHEMTREC), on-site emergency plans (established in advance), off-site emergency plans, and intraindustry systems of mutual aid. Emergency plans of firms must be coordinated with those of local authorities. Employees in firms and the general public must be kept informed of new programs and policies designed to deal with a crisis.

Organizations, whose morale and stability are based on the premise that the exceptional will not occur, must not, in a crisis, withdraw from the many public demands placed on them. They will be inclined to say that "everything is under control," but the public will believe just the opposite.

Community leaders should have already studied other major crises in order to understand how to cope with the reality of the current situation. They must efficiently manage information and mobilize analysts, decision makers, and other individuals who may not have worked together before. They must also provide correct, consistent, and up-to-date information to the media; silence may imply guilt, justifiably or not.

Top management will be sucked into the crisis as well. It must be prepared to gather information continuously and interpret and reinterpret it, but there is little margin for error, especially as regards the media. Top management must maintain internal coherence and capability, even though the destructive tendency of crises pulls the other way, creating doubts about the mission, weakening allegiances, fomenting separateness in teams.

The crucial element for management is safety. Hazards and points of vulnerability must be anticipated – for instance, those involving new products, new technologies, new organizational forms, and new business strategies. Many institutional arrangements and policies will have to be reexamined in light of the current crisis – compensation for victims, the possibility of failure of networks, such as the telephone service, or proposed economic solutions that might shortchange

safety at a time when the public is demanding greater safety. It has been unusual for management to have implemented prevention programs or to have made safety goals public prior to the crisis, efforts that would gain it credibility and legitimacy. During a crisis, safety concerns must not be overshadowed by technical, economic, or administrative considerations.

THE PROBLEM OF EQUITY IN CHOOSING SITES

THE COSTS OF CARELESSNESS

Programs for the disposal of hazardous waste are behind schedule and in disarray today. Plans for winning public acceptance of selected sites have generally failed and have sometimes been turned down in volatile anger. Regional compacts have led to balkanization.

One problem is that plans for siting a waste-disposal facility typically are undertaken in isolation rather than as part of the overall "cradle-to-grave" concept, which begins when the waste is generated and then transported to the place where it is stored or otherwise disposed of. Another problem is uncertainty about the likelihood of massive human contamination, a concern that can push the public close to hysteria. The public also remembers past disasters, such as Love Canal, and is unlikely to be soothed merely by more complete and accurate information on the new technology than has been presented previously. Controversies mix factual disagreements and value disputes.

Much of the opposition to waste facilities comes from local residents who perceive an injustice, feeling that industry and the public at large may benefit while they bear all the risks. Studies of equity are few; both theory and experience are lacking. It may be possible

to share the benefits of a disposal facility by the same type of arrangement that taxes the winners and provides compensation to the chosen site. It may be possible to reduce risks by enforcing specific standards and regulations regarding health and safety. Ethical questions also arise: When and for what ends may risks be placed upon others? Who should make such decisions? What rights do risk bearers have?

The problem of dealing with these siting issues is compounded because the public distrusts institutions, including governments, partly because toxic wastes have been badly mismanaged for decades and proper disposal has been neglected. Even good intentions sometimes go awry. The public can be shown a "fault tree" that is designed to demonstrate how small the risks are, yet this leaves the opposite impression by revealing how many things could go wrong.

Finally, the responsibilities for selecting sites differ depending on the type of waste involved. In the US, states have the responsibility for choosing the many sites needed for toxic but nonradioactive waste; regions for low-level radioactive waste; and the Federal Government for high-level waste. There is no coordination between efforts at different governmental levels, although the problems are the same in each group. The result is that few sites for disposal of toxic waste have been selected and developed.

SEEKING CREATIVE IDEAS

There are several models to establish a site:

(1) In a market-based model, risks are frequently borne by poor communities who are least able to pay large sums to avoid having the facility in their backyard.

(2) The model in which a central authority imposes a site appears to be oriented toward protecting health and safety. Such authorities, however, command little trust and confidence and do not

serve to quiet the fears of the public. In fact, opposition to their decisions usually escalates.

(3) In the "bartered consent" model, residents near the chosen site receive compensation as part of a negotiated agreement. This approach presumably converts local opposition into neutral if not positive feelings, helps restore equity, and promotes shared values with respect to the facility. It is the heart of the US Nuclear Waste Policy Act of 1982 – a series of carrots coupled with the Presidential stick of forced selection if a voluntary agreement is not forthcoming. It assumes that, in choosing between sites, benefits can be weighed against risks, that compensation can be determined by specifying the long-term impact of the facility, and that the developer and the regulatory agency can gain social trust. Today, these assumptions are questionable.

(4) The "fairness-centered" model may include mechanisms for conflict resolution. For instance, it might allow for a "siting jury" that always consists of different interested parties, including residents of the areas under consideration. Alternatively, it might select an *ad hoc* commission to determine the location of the facility from a list of certified sites. Or a lottery might be utilized. Such approaches have not been widely discussed to date, but given the failures of existing institutions, these new approaches may be worth trying.

In addition to conceptualizing the siting problem as a systems-level task, a new paradigm must have an ethical basis. It must recognize that some individuals will have to bear risks for others, but the imposition on these should be voluntary if possible; that risks should be avoided, wherever cost-effective; and that unavoidable risks must be compensated through sharing the winners' gains with the potential losers.

7

IMPLEMENTING THE RISK-MANAGEMENT TOOLS OF INSURANCE, COMPENSATION, AND REGULATION

THE PROBLEM

Balancing the benefits and costs associated with hazardous materials is difficult. A mix of regulatory and market forces ought to assure a viable and safe infrastructure for the transport and use of these materials. However, we need to know how different interested parties weigh and evaluate the various consequences of regulatory and policy options. Can insurance and compensation sufficiently redress the balance with respect to risks, costs, and benefits in the management of hazardous waste?

A MODEL FOR SITING

The question bears initially on the economic, environmental, and health effects of the transportation, treatment, and disposal of hazardous waste. Insurance, liability, and safety measures are joint, rather than separate, issues. A generator or a transporter of waste accepts risks according to the anticipated liability and compensation arrangements. For example, if the private cost to a profit-oriented firm is lower than the social cost of an accident, the implication is that the

level of care taken by the firm will be insufficient. The incentive to make investments in safety is greater if a firm can thereby reduce its liability. On the other hand, if firms perceive that their reputations are at stake if their activities adversely affect human health and safety, they may spend more on waste reduction than is socially optimal.

There are further complexities in designing optimal strategies for managing hazardous materials. A firm faces trade-offs between enhancing its output and taking protective measures, since its own resources are finite. Furthermore, not all damages can be expressed in monetary terms, particularly environmental and health effects for which there are often no easily assignable causal agents. In fact, the uncertainties associated with non-sudden "accidents" make it virtually impossible to assemble a predictive data base for assessing risks. Under the "polluter pays" principle, many victims would not be compensated by firms that have only limited assets. On the other hand, under the "public pays" principle, firms have limited incentive to undertake protective measures. An appropriate decision regarding an acceptable level of risk requires a balance between enforcement costs, incentives, and the inequity of leaving some victims uncompensated.

Compensation and insurance can help choose a feasible and appropriate site, but who is to participate in the negotiations process? Several parties can be identified as integral:

(1) The firms that generate the waste (they want to continue producing their goods; they are also partially liable, according to US law, for the costs of accidents).
(2) The facility developers, who have a financial incentive to compensate the host community, perhaps through taxes (they should also be prepared for liability claims).
(3) The host community, to whom the gains are limited and the costs possibly large.

(4) The insurance companies, which face the uncertainties inherent in accidents at hazardous-waste facilities and in court settlements.
(5) Other residents outside the area of the facility who benefit from the goods and services produced by the firm that generates the hazardous waste.

SUBSEQUENT STAGES

In building the facility, the developer will probably have to offer the community either monetary compensation or payment in kind. If compensation is interpreted as a bribe, then the term "benefit sharing" may be more palatable. In living with the facility, residents will worry about property values and economic development. Developers might not know what to offer because fair market values are difficult to determine in the absence of a facility. If premiums are based on risk, insurance might encourage firms to invest in better plant design and other protective measures; arrangements can also be made to monitor and control plants.

Accidents involving hazardous wastes must be anticipated. A long latency period before health consequences reveal themselves make traditional insurance arrangements inadequate. Private and public sectors may have to combine to form insurance programs, making use of claims-made policies, trust funds, and an industry-wide self-insurance fund. (The latter sort of fund may have one major administrative problem – monitoring, to make sure that participants, secure in the knowledge that they are insured, do not exhibit carelessness.)

Not all of the stakeholders have an equal interest at each stage of development. The public has been shown to be disturbed most by the dread and unknowability of hazardous-waste risks. Compensation, or benefit sharing, will likely have to be relatively high when both of these factors characterize the risk of a proposed technology. There may be justifiable differences of opinion: the industry and the developer may know the technology well and feel that it carries a

minimal risk, while the public, not knowing this, may feel otherwise.

The probability of accidents will be difficult to assess. Some accidents, in fact, are so unlikely that there will be no practical basis for statistically estimating their chances of occurring. Insurers will not be interested in selling coverage because of the uncertainty. On the other hand, the potential host community may imagine the losses graphically – and consequently overestimate the potential losses rather than focus on their relatively low probability of occurrence.

The true willingness of an individual or community to accept a facility that might harm them but benefit others is not easily measured. Considerations of equity and fairness complicate the matter, as do institutional arrangements for designing appropriate mechanisms for compensation. In general, insurance policies and compensation cannot stand by themselves; they must be integrated into a broader framework. After sites have been selected for their economic and environmental suitability, the values of each interested party must be determined. A "value tree" analysis might be helpful in this process. It often reveals conflicts among the stakeholders and lay out possible benefit- and risk-sharing options. The government's role as a monitor can also be spelled out.

Four criteria are useful for siting a hazardous materials facility:

(1) The siting process should be open, allowing public participation in the final decision.
(2) Deadlines are necessary to prevent foot-dragging.
(3) Siting arrangements must be specified and the expected gains and losses clearly delineated.
(4) Insurance, compensation, and regulatory mechanisms should be considered, recognizing that they will have different uses under alternative measures of societal welfare.

Overlapping jurisdictions create further complications – for instance, classification of wastes, documenting and reporting flows across borders, agreement on

financial responsibility and liability, development of the infrastructure, and assurance that the facility has sufficient demand.

Much remains to be learned: How do firms respond to the policy tools of insurance, compensation through negotiation, and regulation? How can the stigma of compensation be overcome? We lack empirical validation of theories of bargaining and collective-choice procedures with respect to managing hazardous materials. Insurers need creative policies to grapple with the uncertainties associated with the probability of accidents and the ensuing consequences. If private insurers cannot provide coverage, industry-wide self-insurance programs should be considered. Finally, the courts and the government must learn to appreciate their respective roles in the process of managing hazardous materials.

THE CONFERENCE PROCEEDINGS

The Conference Proceedings will be published in book form under the title *Insuring and Managing Hazardous Risks: From Seveso to Bhopal and Beyond*, edited by Paul Kleindorfer and Howard Kunreuther.

The book is divided into four parts. Part One provides perspectives on the nature and magnitude of accidents and losses from previous technological disasters, notably Seveso and Bhopal. Aspects considered are the reactions of organizations and public authorities to crisis situations, errors in technical design and/or management, problems of public health and evacuation, and the extent of environmental damage and its insurability.

Part Two deals with the relationships between production, transportation, handling, storing, and disposal of hazardous materials and the policy instruments of insurance, compensation, regulation, and negotiation. In particular, it examines the use of insurance and compensation to share regional benefits from a hazardous-waste facility with those at risk from the facility; the importance and difficulties of negotiations

to spread risks and benefits, and to gain informed consensus; and the problems of winning and maintaining public trust in the resolution of these conflicts.

Part Three discusses the traditional problems of hazard identification, risk estimation, risk evaluation, and related perception and communication problems. In particular, it explores in detail the complex relationships between chemical risk analysis and management; the practical use and promise, as well as pitfalls, of risk analysis for insurers and industry; the problems of communicating efficiently with the public and understanding their anxieties; and the use of value tree analysis to assess the stakes held by various parties in policies that affect the risks associated with hazardous materials.

Part Four focuses on appropriate policy instruments for mitigating risks, reducing or eliminating risks, spreading risks, and absorbing the financial and other loss potential of risks in socially and financially acceptable ways. In particular, chapters compare regulatory styles for hazardous waste management in various countries; the legal background of liability insurance and its effectiveness in preventing risk or satisfying the public; and the prospects of environmental impairment liability (EIL), in terms of land-based incidents and transportation of hazardous wastes by sea, and institutional reasons for the decline of EIL.

The book also contains commentaries on some of the chapters to reflect the often very active exchanges between Conference participants on various topics. Finally, since a major objective of the Conference was to plan a research agenda for the next decade, we summarize in the Epilogue the recommendations produced at the concluding plenary session.

CONTENTS OF THE BOOK

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