the workplace. First, OSHA published a detailed proposal in the *Federal Register* and invited public comment. This was followed by a lengthy hearing in Washington, D.C. The Dow involvement included a written package containing information similar to that provided for criteria development. It included our analytical methodology, toxicological studies, industrial hygiene data, process descriptions, economic evaluations, work practices, training programs, medical surveillance data, and other information. Dow scientists also testified at the hearing and engaged in the cross-examination of expert witnesses. Dow involvement was extensive. Between January and July of 1978, we invested over 1 $^1/_2$ man years of effort on this one topic.

Because of environmental concerns, Dow receives many requests for information from the Environmental Protection Agency. These relate to air and water standards, emission data, feasibility studies, and other factors. For instance, certain requests for information on water effluents are commonly referred to as "308 letters". Such a letter requests data on our effluent flows and composition, performance of pollution control devices, pollution control costs, and concentration of various pollutants (known as priority pollutants). We expect well over a hundred such requests this year. One such "308 letter" (although happily not typical) is certainly worthy of mention. It was 23 pages long, involved nine plants, and required our compilation of over 6000 different effluent stream analyses. Our final response was over 500 pages long and required an investment of more than 1700 man hours.

Such requests demand more than just willingness to cooperate. If compliance is to be responsible, they require enormous expenditures of technical talent, time, and dollars, which should be directed to the highest priority needs. Add to these examples additional requests for air emissions data (seeking to define emission levels and to determine best available technology), and the magnitude of this informational problem is obviously both a challenge and a burden. It is essential that a company's resources be very carefully allocated in responding to such requests.

The problem of balanced and reasonable technical interface between industry and regulatory agencies grows increasingly complex. Based on the Dow experience to date, several areas can be identified for significant improvement if our country is to receive proportional value from the efforts expended.

From industry, there must be a continuing commitment to reasonable regulation. While the efforts required to generate data-based responses for use in setting standards are significant, so are the potential rewards. If such regulations are based on both data and experience, they should be the most reasonable regulations obtainable.

From industry, we need greater realization of the need for flexible and responsive management of demands for health and environmental data. This is important because of problems in allocation of company resources and protection of proprietary or sensitive information. Equally important is the need to influence regulation with sound science.

From industry, it is vital that a high level of technical credibility be maintained by providing reliable data and experience to the regulators.

From government agencies, we would like greater opportunity for technical dialogue. The present method of establishing standards relies on written requests for information followed by adversarial proceedings. This lack of dialogue represents one of the most frustrating experiences in the whole regulatory process. The only answer industry may ever receive to a written position or submission of data is the final regulation. Public hearings are not technical dialogues. The most effective time for technical communication is *before* a regulation is drafted, not while it is being defended.

From government regulatory agencies, we ask greater selectivity in their demands. Agency requests for all information relating to a list of 1500 chemicals, or for all information relative to establishing a standard for the "petrochemical industry", are useless exercises. There can be no meaningful response to such a vague or generic request. There is no way that meaningful regulations can evolve from such nonselective efforts.

From government agencies, we ask that data be demanded only when the data will be used in the decision-making process. There is no justification for creating massive — and grossly expensive — data banks for possible future use. Industry is very apprehensive that EPA's apparent authority to collect data under the Toxic Substances Control Act will be used indiscriminately and will provide little of value in preparing reasonable, necessary regulations.

Finally, we suggest that both industry and government must agree that the real issue is not regulation vs. nonregulation. The issue is reasonable regulation vs. overregulation. If dialogues are established and if the data bases supplied to the government are pertinent and sound, then the eventual outcome should be reasonable health and environmental standards.

The United States' Hazardous Waste Regulatory Program†

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Key elements and status of proposed national standards for hazardous waste regulations and program implementation issues are described.

The United States is developing a new hazardous waste regulatory control program as mandated by the Resource Conservation and Recovery Act of 1976 (RCRA), which amends the Solid Waste Disposal Act. Subtitle C of RCRA requires the U.S. Environmental Protection Agency, in consultation with State governments, to develop national standards for: hazardous waste definition; generators and transporters of hazardous waste; performance, design, and operating requirements for hazardous waste treatment, storage, and disposal facilities; a permit system for such facilities; and guidelines describing conditions under which State governments will be authorized and assisted to carry out the hazardous waste control program. The Federal EPA must implement the program in States which do not seek, or do not qualify for, authorization. Local governments, citizens' groups,

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and the private sector also will participate in program implementation.

All of the national standards mentioned above have been proposed for public comment and are to be finalized no later than December 31, 1979. RCRA provides that these standards will go into effect six months after final promulgation, or in the early summer of 1980.

REGULATORY STRATEGY

The past history of public health and environmental damages resulting from mismanagement of hazardous waste has led to a regulatory approach encompassing transport controls, as well as disposal controls. This "cradle-to-grave" control concept is somewhat unique, but necessary, to ensure that hazardous wastes are handled only at facilities with proper permits. All stages of the hazardous waste management cycle are controlled whether the waste is managed "on-site" at the point of generation or transported to an "off-site" waste management facility.

The regulatory strategy uses a "pathways" approach wherein the path and destination of any hazardous waste is controlled without particular attention to the source. This approach is basically different from that used to regulate air and water pollution where specific standards are written for and tailored to each industrial category. The pathways approach was chosen because hazardous wastes are mobile and can be disposed of at locations far from the generating sources, whereas industrial air and water pollution sources are fixed and relatively easy to identify. Further, the management options for hazardous waste are limited to a few technologies (incineration, treatment, land disposal), which are relatively independent of the source and composition of the waste.

HAZARDOUS WASTE DEFINITION

RCRA requires hazardous waste to be defined both in terms of inherent characteristics, such as flammability and corrosiveness, and by a listing of particular hazardous wastes. EPA has developed criteria for selecting general characteristics and for listing hazardous waste. Based on these criteria, characteristics for ignitability, corrosiveness, reactivity, and toxicity were selected and defined. Any waste which meets any characteristic is considered to be a hazardous waste. In addition, lists of hazardous wastes, hazardous waste sources, and processes known to generate hazardous wastes have been developed based on data which show these wastes either have the characteristics noted above or meet the statutory definition of hazardous waste.

Before a material can be defined as a hazardous waste, it must first be established that the material is a solid waste. RCRA uses the phrase "other discarded material" in its definition of solid waste. EPA has proposed to define this phrase to mean any material which is: (1) abandoned or committed to final disposition; (2) reused, if such use constitutes land disposal; and (3) a waste oil, if it is incinerated or burned as a fuel.

Under this definition, for example, used solvents sent to a solvent-reclaiming facility would not be considered a discarded material, and, therefore, would not be considered a solid waste or a hazardous waste. Consequently, a solvent-reclaiming facility would not be subject to regulatory controls under RCRA. However, a solvent reclaimer could be a hazardous waste generator subject to control if the residue from the solvent reclaiming operation is hazardous. Similarly, materials being transferred between industrial facilities via a waste exchange would not be subject to hazardous waste controls. These are examples of EPA's intent to encourage resource conservation and recovery by judicious structuring of the regulatory controls.

However, materials reused as soil conditioners, fertilizers, fill material, or dust suppressants are retained within the control system, since reuse of materials in this manner could result in serious adverse impacts due to uncontrolled release and dispersion of contaminants into the environment. In the proposed regulations, waste oils are singled out for special control because the use of waste oils for dust suppression or incineration of these oils has been known to cause serious environmental effects.

HAZARDOUS WASTE CHARACTERISTICS

Definition of hazardous waste by general characteristics implies that test protocols for such characteristics are available for waste mixtures in solid, sludge, or liquid form. After consideration of eight candidate characteristics, EPA has selected and defined ignitability, reactivity (or explosiveness), corrosivity, and toxicity (based on potential impact on drinking water) as general characteristics for the initial phases of the hazardous waste regulatory program. These four characteristics are the only ones for which EPA confidently believes test protocols are currently available in a regulatory sense. EPA intends to expand the set of characteristics to include radioactivity, unnatural genetic activity, bioaccumulation, and toxicity to aquatic organisms, terrestrial plants, and humans (via chronic exposure to organic chemicals) in future years. Meanwhile, certain specific wastes known to have these latter characteristics have been placed on the hazardous waste lists and are subject to regulatory control.

Several of the test protocols now defined are identical with those used under the hazardous materials transport control program administered by the U.S. Department of Transportation. The toxicity characteristic uses an extraction procedure intended to simulate potential leaching of hazardous constituents from waste, if disposed improperly, and subsequent migration through soil to underground drinking water supplies.

HAZARDOUS WASTE LISTS

The second way a waste can be brought into the hazardous waste regulatory program is by including that waste on a list. This is the most common method for hazardous waste definition in European countries and in some States in the United States. Actually, there are four EPA hazardous waste lists including: (1) a list of generic hazardous waste common to many different sources, such as paint waste, etching acid solutions or sludges, or electroplating wastewater treatment sludges; (2) a list of known sources of infectious hazardous waste, such as hospital pathology departments; (3) a list of industrial processes known to produce hazardous waste, such as mercury bearing brine purification muds from the mercury cell process in chlorine production; and (4) a list of substances which if disposed in pure form or as a result of off-specification production would be hazardous (examples are hydrocyanic acid and pentachlorophenol).

EPA has chosen to emphasize waste streams rather than specific chemical substances in these lists wherever possible because industrial wastes tend to be complex mixtures containing many different components. This approach will relieve waste generators of much of the testing burden and uncertainties which are involved in relating a waste containing many substances to a list of specific substances. There are about 175 hazardous wastes, sources, and processes on EPA's lists as currently proposed. In addition, there are 275 specific substances listed.

HAZARDOUS WASTE GENERATORS

The standards for hazardous waste generators require them to keep records, make annual reports, ensure proper containerization and labeling of hazardous waste shipped off-site

for disposal, and originate a transport manifest document for each shipment describing the content, amount, and destination of each shipment. In the proposed regulations, retailers, farmers, and generators of small amounts of waste (<100 kg/mol) are excluded from these requirements provided they dispose of waste in State-approved facilities. Generators do not need permits.

The regulations are structured to place substantial responsibilities on waste generators. They are required to make the basic decision as to whether or not their waste is hazardous by reference to the lists, by testing wastes against the characteristics, or by simply declaring the waste to be hazardous if they do not wish to test it.

Generators are also the key link in the transport control system. They must originate the transport manifest document for each waste shipment, they must select a responsible transport company to carry the waste, they must specify the facility to which the transporter is to take the waste, and they must assure in advance that this facility has a valid permit to handle their waste. If generators have not received a confirmation that their waste was, in fact, received by the intended facility within 30 days of shipment, they must notify the regulatory authorities.

For international shipments, hazardous waste generators are required to notify the responsible authorities of the country in which the receiving facility is located within 7 days after shipment.

In an effort to lessen the regulatory burden on the large number of generators of waste oil, as well as to promote resource recovery, the proposed regulations allow regulated transporters or owners/operators of permitted facilities to assume all of a waste oil generator's obligations, such as recordkeeping, preparing manifests, etc., except the duty to apply for a generator identification code.

HAZARDOUS WASTE TRANSPORTERS

Hazardous waste transporters are required to take the hazardous waste shipments only to the permitted facility designated by the generator, to keep appropriate records, and to report any spills enroute. Transporters do not need permits either, in the Federal system, but some States require hazardous waste transporters to be registered.

A major problem in the past has been that some irresponsible transporters have been paid by generators to take hazardous wastes to disposal facilities, but instead these transporters have merely dumped the waste alongside roads, on farms, down sewers, or on abandoned property. For example, the sewage treatment plant in Louisville, Kentucky, had to be shut down for several months in 1977 after a local transporter dumped many drums of hexachlorocyclopentadiene waste down a sewer there. It cost the Federal government several million dollars to clean up the sewer and the treatment plant. During cleanup, raw sewage had to be discharged directly to the Ohio River. The transport manifest system is designed to prevent such practices because generators will know whether or not the designated facility actually received the wastes shipped, and can quickly identify the transporter involved to enforcement authorities.

The RCRA hazardous waste transporter standards are being closely integrated with hazardous material transport regulations administered by the U.S. Department of Transportation. Ultimately, EPA expects that these two programs will be implemented and enforced jointly.

HAZARDOUS WASTE MANAGEMENT TECHNOLOGY

At this point I would like to make some general observations about hazardous waste management technology from a national perspective before I review highlights of EPA's proposed technology standards for hazardous waste management facilities. In doing this it is important to understand that the context of these remarks is in terms of definitions in the Resource Conservation and Recovery Act. These definitions are not always the same as general usage.

RCRA defines disposal as deposit of hazardous wastes into or on land or water in such a way that hazardous wastes or constituents from the waste may be emitted to air, surface water, or groundwater. In other words, disposal implies an actual or potential discharge or emission to the environment. Under this definition, landfills and surface impoundments are disposal options.

RCRA defines treatment as physical, chemical, or biological processes intended to detoxify or neutralize hazardous waste or to reduce their volume or to make hazardous waste amenable for recovery, storage, or transport. Under this definition, for example, incineration, cyanide reduction, acid neutralization, and chemical fixation are treatment options. Landfarming falls somewhere midway between disposal and treatment, since the method involves biological treatment of waste by soil organisms, but there is usually a residue remaining which is, in effect, disposed of on land.

This leaves the RCRA definition of storage, which means containment of hazardous waste so as not to constitute disposal. Since disposal includes emissions to air as well as to surface water and groundwater, storage implies closed containers or tankage with vent controls.

I would like to emphasize that from a national perspective, the hazardous waste management program is *not* technology limited. The majority of hazardous wastes can be, and some are, safely landfilled using available techniques. Many hazardous wastes can be, and some are, adequately destroyed by high-temperature incineration or physical, chemical, or biological treatment methods which are currently in use. Almost any hazardous waste I know of can be safely stored temporarily if none of the landfilling or treatment or incineration options are available.

There are four major issues pertaining to this point. (1) Adequate technology costs more than people have been used to paying in the past. (2) Landfill methods are greatly dependent on local conditions of soil properties, rainfall, geology, and hydrology, and there may well be areas where landfills are not suitable at all. (3) Since some hazardous wastes are essentially indestructible in a landfill environment, the true cost of land disposal includes monitoring and maintenance activities long after landfills have been closed. Also, the legal liability for hazardous waste disposed of in landfills remains long after closure as well. Until recently, these costs have neither been recognized nor charged to customers. (4) Because the problems of inadequate past disposal practices are now gaining public attention, citizen opposition to new facilities is growing, particularly for landfill disposal facilities.

Consequently, EPA states in the proposed regulations that disposal of hazardous wastes should be avoided where possible and that other alternatives such as incineration, treatment, and recovery and reuse should be employed. While we recognize that there will always be a need for landfill disposal facilities, the wave of the future is in treatment or recovery facilities. In future meetings we may have sessions entitled, "Treatment Technology" rather than "Ultimate Disposal", and as the true cost of disposal and treatment technology begins to be applied, including the legal liability costs, we anticipate that hazardous waste generators will turn increasingly to material substitutions or process changes which will eliminate or greatly reduce the amounts of hazardous wastes produced.

EPA's proposed hazardous waste regulations reflect this general view of hazardous waste management technology and

the economic and public acceptance aspects of applying various technology options.

HAZARDOUS WASTE FACILITY STANDARDS AND PERMITS

National standards for hazardous waste treatment, storage, and disposal facilities not only establish acceptable levels of performance that such facilities must achieve, but also are the criteria against which regulatory officials will measure applications for permits. In the proposed facility standards, EPA has relied primarily on specific design and operating standards, as opposed to general ambient or source emission standards, because they are more easily understood and enforced than other types of standards.

The design and operating standards are divided into four overlapping categories: (1) general standards applicable to all types of facilities, including requirements for location, security, contingency plans, training, financial responsibility, monitoring, etc.; (2) standards for storage applicable to all facilities where hazardous waste is stored for more than 90 days; (3) standards for treatment and disposal including explicit requirements for incineration, landfills, surface impoundments, land farms, and chemical/physical/biological treatment; and (4) standards applicable to special waste categories EPA has identified which require special handling because the waste is produced in very large quantities, presents a relatively low level of risk, and may be unsuitable to normal control techniques.

To gain a feeling for the comprehensiveness of these proposed regulations, consider the following highlights:

1. General standards which apply to all hazardous waste management facilities:
   a. *Location limitations* for certain areas such as fault zones, flood plains, wetlands, critical habitats for endangered species, and recharge zones of sole source aquifers. In addition, the proposed regulations establish a 200-ft buffer zone from active portions of the facility to the property line.
   b. *Security* requirements governing access, including fencing and warning signs.
   c. *Emergency procedure* requirements which require alarms and firefighting equipment as well as a contingency or action plan to be implemented in the event of an emergency.
   d. *Training* programs are required to ensure that employees know how to do their jobs in a manner which will avoid accidents potentially hazardous to public health.
   e. *Closure* and *postclosure* procedures which require specific steps to minimize residual hazards at a closed facility and postclosure monitoring at landfills for 20 years after closure.
   f. Minimum requirements for *groundwater and leachate monitoring* at landfills and surface impoundments which include periodic sampling from monitoring wells and leachate collection systems and testing on a set time schedule.
2. *Storage standards* are proposed to ensure zero discharge to the environment including spill containment and venting controls.
3. *Incineration* specifications, as proposed, require wet scrubbers for halogens, time, temperature, and excess oxygen minimums, destruction and combustion efficiencies, and continuous monitoring of temperature and carbon monoxide, as well as automatic feed cutoff in case of malfunctions. While general standards of 1000 °C, 2 s dwell time, and 2% excess oxygen apply, incineration at lower temperatures and dwell times can be allowed if the facility operator can demonstrate that an equivalent degree of combustion will be achieved.
4. *Landfill* regulations have a series of alternative liner and leachate collection combinations coupled with compatibility requirements and minimum distances of 5 ft underneath the landfill to groundwater and a lateral distance of 500 ft to any water supply sources. Also, there is a general prohibition on landfill disposal of ignitable, reactive, incompatible, and volatile wastes, and bulk liquids unless mixed with an absorbent material.
5. *Surface* impoundments must meet most of the same requirements as landfills but also have a minimum 2 ft free-board requirement and also special closure requirements.
6. *Landfarming* controls will prohibit growing foodchain crops on lands upon which hazardous wastes have been placed and also limit the spreading of volatile materials.
7. *Chemical, physical,* and *biological treatment* facilities will be required to conduct trial tests of each waste and treatment process combination; each situation will be separately considered.

Recognizing that specific design and operating standards might discourage the development of new technologies and that different design and operating standards might be appropriate for a facility which is disposing of only one type of waste, EPA has inserted "Notes" after certain proposed standards which describe the circumstances for deviation from the specific standard to which the Note applies. Generally, the Notes allow deviation from a specific requirement when the applicant for a permit can demonstrate that an alternate requirement or an existing natural condition at the facility site will achieve at least an equivalent degree of containment, destruction, or environmental protection as the specific standard would provide. Thus, the Notes allow permit issuing authorities a certain flexibility or latitude to interpret national standards by taking into account local conditions while still achieving equivalent performance.

In addition to the design and operating standards, the proposed regulations contain three overriding standards called human health and environmental standards. These are designed to provide a failsafe mechanism for the protection of groundwater, surface water, and air quality. No matter how specific and inclusive the design and operating standards are, there will nevertheless be a few unusual situations where use of those standards will not achieve the intended level of performance. Rather than trying to make the design and operating standards much more stringent to cover a small set of marginal situations, EPA has chosen to use the override mechanism of the human health and environmental standards where necessary.

Finally, EPA has proposed a selected set of requirements called interim status standards which apply to hazardous waste facilities which have pending permit applications between the time the regulations become effective and the time a permit is issued. Because of the large number of facilities potentially requiring a RCRA permit (estimated at about 30 000) and limited EPA resources, it may take several years before a permit is issued to all facilities.

EPA is actively developing an integrated facility permit approach such that nearly identical administrative rules apply for hazardous waste permits under RCRA, for water discharge permits under the Clean Water Act, and for underground injection (deep well) permits under the Safe Drinking Water Act. This approach allows facilities to be issued one combined permit for all these activities. This should result in substantial time and cost savings.

STATE HAZARDOUS WASTE PROGRAMS

Congress intended that the Federal EPA establish national standards for hazardous waste management, but that the

individual States implement and enforce this new regulatory program. EPA has proposed a guideline which describes the elements a State hazardous waste program must have in order for a State to be authorized to carry out the national program. Among other things, States must have legislation and regulations for hazardous waste management which are no less stringent than the Federal analogs, and must demonstrate that they have adequate resources to administer and enforce the program. States may be given interim authorization to carry out the program for a period of two years, even if they do not fully qualify. During this two-year period, States would be expected to develop a program which meets all authorization requirements. Federal financial grants are available to assist States to develop and implement fully acceptable hazardous waste management programs. EPA is required to operate the hazardous waste program in States which do not qualify for authorization.

IMPLEMENTATION ISSUES

Several major issues of implementation have arisen for this new program. One involves the interstate movement of hazardous waste. Some States believe it is within their powers derived from the U.S. Constitution to ban the disposal of wastes originating in other States. This approach runs counter to the concept of large regional hazardous waste facilities which, owing to the economics of scale, could operate at lower cost than smaller facilities. The issue is politically and emotionally charged, and not yet fully resolved. However, the U.S. Supreme Court ruled in June 1978 that certain types of State waste importation bans are a restraint on interstate commerce and therefore unconstitutional.

A related issue is the potential lack of acceptable hazardous waste facility capacity to accommodate all the hazardous waste which will be regulated under this new program. State waste importation bans discourage private sector investment in new facilities, since many facilities would have to draw wastes from an area encompassing several States in order to be economically viable. Another factor is citizen opposition to the siting of new facilities near them. In fact, an existing hazardous waste facility in Illinois with valid State permits was closed down by court order in September 1978 as a result of local citizen opposition. New approaches to hazardous waste facility siting are being considered to overcome this problem.

Another issue is the new requirement for financial responsibility for owners and operators of hazardous waste facilities. In the past, several facility owners have taken in large quantities of hazardous waste for treatment or disposal, but then declared bankruptcy before these wastes were adequately disposed. Local or State governments were then faced with the job of cleaning up the problem at taxpayers' expense. To preclude these events in the future, the proposed hazardous waste regulations require that facility owners deposit sufficient funds for ultimate facility closure in a trust account before an operating permit is issued. Further, facility owners must show proof of financial responsibility to handle liability claims and to conduct remedial actions, if necessary, during facility operations. Lastly, land disposal facilities, such as landfills, land farms, or surface impoundments, must build up a fund during the facility lifetime to pay for monitoring, security, and maintenance at the facility for a 20-year period after closure. These proposed requirements are likely to force small operators out of the hazardous waste management business, and thus may add to the facility availability problem. However, RCRA provides that existing facilities can obtain interim status prior to permit issuance. This interim status period can be viewed as a safety valve for capacity creation in the program start-up period.

Information Systems for Optimum Use of Ocean Resources†

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The world's oceans offer tremendous potential for providing food, energy, metals, minerals, and recreational experiences. If we are to achieve optimum use of the oceans' resources, then we need to have readily available a variety of information on them: their location; their chemical, biological, and physical makeup; the extent to which they can be extracted and used; and how such extraction may affect us and our environment. This paper (1) indicates the large amount and variety of information now available on the oceans; (2) describes U.S. and international systems for making ocean information available to users; and (3) discusses factors that need to be considered in the further development of ocean information systems.

The oceans, which cover two-thirds of the earth's surface, offer tremendous potential for providing food, energy, metals, minerals, and recreational experiences. If this potential is to be realized, the oceans' resources must be managed to achieve optimum use. Optimum use of ocean resources means optimizing a complex mix of biological, chemical, physical, economic, legal, political, and aesthetic factors. The quantity and quality of information available on each of these factors can have an important bearing on optimization decisions and on the resulting effects of those decisions on the future health and wealth of the world's oceans.

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I. OCEAN INFORMATION

A surprising amount of information is being produced on the oceans, on the location and makeup of ocean resources, on the possible uses of those resources, on the processes for extraction, and on the effects of extraction processes on us and our environment. The National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce is a major producer of ocean information. NOAA has as one of its charters the exploration, researching, and mapping of the global oceans and their living and mineral resources. NOAA uses new biological, chemical, and physical knowledge to assess the sea's potential yield, and to develop techniques that can be used to manage, use, and conserve the animal and