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HAZARDOUS WASTE CLEANUP — A CASE STUDY FOR DEVELOPING EFFICIENT PROGRAMS

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HAZARDOUS WASTE CLEANUP — A CASE STUDY FOR DEVELOPING EFFICIENT PROGRAMS*

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ABSTRACT

As officials in Pacific Basin Countries develop laws and policies for cleaning up hazardous wastes, experiences of countries with such instruments in place may be instructive. The United States has addressed cleanups of abandoned hazardous waste sites through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The U.S. Congress enacted CERCLA in 1980. The task of cleaning up waste sites became larger and more costly than originally envisioned and as a result, Congress strengthened and expanded CERCLA in 1986. Today, many industry representatives, environmentalists, and other interested parties say the program is still costly and ineffective, and Congress is responding through a reauthorization process to change the law once again. Because the law and modifications to it can affect company operations and revenues, industries want to know the potential consequences of such changes. Argonne National Laboratory (ANL) recently developed a baseline for one economic sector — the U.S. energy industry — against which impacts of proposed changes to CERCLA could be measured. Difficulties encountered in locating and interpreting the data for developing that baseline suggest that legislation should not only provide for meeting its stated goals (e.g., protection of human health and the environment) but also allow for its efficient evaluation over time. This lesson can be applied to any nation contemplating hazardous waste cleanup laws and policies.

INTRODUCTION

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund, as it is more commonly known) was enacted in 1980 to provide for federal response to spills and other actual or threatened releases of hazardous substances. During the past several years, industry, environmentalists, public interest groups, regulators, and others have criticized the Superfund program as costly, ineffective, and otherwise "broken." The law is due for reauthorization, and suggested changes range from trying to make the law more fair to transferring authority to the states, thereby curtailing federal involvement except in emergency situations. As part of the reauthorization process, legislators seek information on how well the existing law is working and where weaknesses may exist. By collecting and analyzing hazardous site cleanup data for one particular industry — the U.S. energy industry — ANL recently supported the U.S. Department of

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Energy in providing input to the reauthorization process. This effort yielded a baseline of information on energy-industry involvement at hazardous waste cleanup sites against which the impacts of proposed changes to CERCLA could be measured. Because of difficulties encountered in collecting the data, the actual process used to develop the baseline provides a case study for use in developing "good" hazardous waste laws.

A "good" hazardous waste law can be characterized as one that meets its objectives (e.g., protects human health and the environment), is fair (e.g., those causing the harm should remediate the waste site), cost-effective (e.g., the costs of cleaning up waste sites relate to the benefits derived from cleanup), and includes mechanisms to measure its effectiveness. Lawmakers can supplement these core elements with a variety of other objectives, such as: controlling acute threats immediately; emphasizing enforcement (e.g., encouraging or compelling responsible parties to conduct more cleanups themselves); addressing the worst sites first; monitoring and maintaining sites over the long term; and encouraging public participation in decision making. Lawmakers should develop legislation that meets the needs of the citizenry, reflects the existing government structure, and is consistent with the culture and general conditions of the country in which it will apply.

This paper highlights the basics of environmental legislation, presents the case study in which a baseline of energy-industry involvement at hazardous waste cleanup sites was developed, assesses the results of that case study in the context of developing "good" laws, compares U.S. cleanup laws with those in two other countries, and suggests points for lawmakers to consider when developing hazardous waste cleanup legislation.

DEVELOPING AND REAUTHORIZING ENVIRONMENTAL LAWS

Measuring the Effectiveness of Legislation in the Modern Administrative State

Modern legislation may be described as an institutional method by which the legislature, the basic policy-making body in a democratic society, issues directives to government mechanisms that implement the policy.[1] Implementation is the practice by which legislation and other statements of policy are made to affect persons, organizations, and resources. The implementing institutions are generally administrative agencies and courts. In writing statutes, the legislature enjoys a wide margin of freedom on how to proceed. It can prohibit an activity; set up restrictions on when, where, or how an activity can be carried out; assign to a regulatory agency the task of administering or managing an activity; or merely provide incentives or disincentives for taking certain actions.

One criterion of a good law is that it should achieve the purpose for which it was designed. This can be done in at least two ways. First, the legislature could simply enact its goal as a law, and then direct the implementing agency to achieve the effect. Second, the legislature could not only enact a law, but also the specific administrative strategy to be used by the implementing agency. Thus, legislation can be broad and framework-like — as is the National Environmental Policy Act (NEPA). In NEPA, Congress expressed a policy of the federal government to administer all programs in an environmentally sound fashion, leaving the definition of what constitutes sound to each agency. Legislation can also be definite and narrow as in the Medical Waste Tracking Act (MWTA), in which

Congress prescribed what wastes must be tracked, who must track them, and what the tracking vehicle must include.

But how is achievement of legislative goals determined? An institutionalized form of post-implementation evaluation is the so-called sunset legislation. To ensure regular evaluation, certain public programs are limited to a maximum period of validity. They can only be continued if explicitly approved by the legislature, often after an evaluation of the program. This legislation includes a schedule for the expiration of a program if the legislature does not provide otherwise. Effectiveness can also be measured through required reports to Congress on various operational aspects of a program. For example, one version of a bill before Congress on regulatory reform in the environmental arena contains a provision requiring federal agencies to report to Congress annually on whether their implementation of certain risk assessment provisions has created any significant regulatory program management complications.

Reauthorization in the United States

Before U.S. Treasury money can be spent, Congress must pass both authorization and appropriation legislation. Authorization refers to basic legislation that establishes or continues the legal operation of a federal program or agency. An authorization bill specifies a program's or agency's purposes and conduct and establishes a ceiling for money that can be used to finance a program or agency. An appropriation bill provides the money approved in one or more authorization bills. The number of years for which the money is available (i.e., the "sunset") is set in the authorization bill. If the program or agency is to continue, then the legislation must be reauthorized. Reauthorization serves several purposes. Most importantly, it provides a hiatus to revisit, reevaluate, and amend the legislation. Amendments are needed if conditions at the time of initial authorization or a prior reauthorization have changed. In some cases, the legislation may have worked well and needs to be expanded. In others, flaws must be remedied. While Congress can amend laws independently of authorized schedules, reauthorization provides a defined opportunity to amend the substance of the law. Reauthorization amendments can be major, minor, or even postponed. In some cases, reauthorization will extend current or provide additional funding. For some laws, authorization is open-ended or "permanent," and formal reauthorization is not necessary.

Reauthorization Procedures in Other Countries

The terms reauthorization and sunset legislation are not typically used in the context of legislation in other countries. Rather, legislation is amended or superseded on an as-needed basis. Laws are then cited with their original name (and date of enactment) followed by an indication that the law applies in the version of the amending law (specified by the date of enactment). Nevertheless, the concept of "timing" in legislation does exist. For example, Germany has enacted laws with limited periods of effectiveness (e.g, procedural regulations in the administrative court system). Two reasons for limiting the period of validity are: (1) a certain provision is only required for a foreseeable period of time; and (2) a certain provision may have a time limit because it is of an "experimental" nature. In addition, major German legislation contains dynamic control provisions facilitating the automatic

incorporation of current economic, technical, and social developments into the statute. For example, in the Federal Immission Control Act** [translation by the authors] (*Bundesimmissionsschutzgesetz*) and the Atomic Energy Act (*Atomgesetz*), the references to the "state of art" or "state of science and technology," respectively, ensure that the authorization for the building and running of a chemical or nuclear plant will depend on the observance of the most advanced security standards. This dynamic is the focal point for interaction between the legislature and implementing agency in terms of status reports, oversight hearings, personal contacts, budget authorizations, and proposed or enacted amendments, and thus provides the basis for potential revisions of the law.

U.S. HAZARDOUS WASTE CLEANUP LEGISLATION

In the United States, there are two major federal laws pertaining to hazardous waste: the Resource Conservation and Recovery Act of 1976 (RCRA) and CERCLA — the hazardous waste program examined in this paper. RCRA seeks to prevent threats to human health and the environment by mandating "cradle-to-grave" management of hazardous waste from generation through disposal. CERCLA strives to remedy hazardous waste problems at contaminated sites that are inactive, old, or abandoned, and lack financially viable owners. Thus, RCRA sets up a regulatory program for present hazardous waste activities, and CERCLA establishes a comprehensive response program for past hazardous waste activities.

The key objective of CERCLA is protection of human health and the environment. The law provides several ways to achieve this goal. First, based on the premise that polluters should take responsibility for remedying the harm caused by their wastes, it provides unparalleled enforcement powers, Thus, the U.S. Environmental Protection Agency (EPA), which administers the CERCLA program, can require responsible parties to conduct site cleanups or it can conduct the cleanups and recover its costs from the liable parties later. Second, CERCLA provides authority for federal response if responsible parties fail to take timely action. Third, it establishes a Hazardous Substances Response Trust Fund, "the Trust Fund" to cover enforcement and cleanup costs. Most Trust Fund money comes from excise taxes on petroleum, chemicals and corporate income. To date, Congress has authorized about $15 billion for the Trust Fund.

EPA evaluates the need for cleanup at sites brought to its attention, identifies parties liable for cleanup costs, and oversees site studies and cleanups. It has developed a list of approximately 37,500 sites that may warrant Superfund response. The most serious of those sites are listed on the National Priorities List (NPL), and are priorities for long-term remedial evaluation and response. As of

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** The choice of words is noteworthy. The German language, in consonance with the Latin, distinguishes between *Immissionen* and *Emissionen*, while the English language only uses *emissions*. In German, *Immissionen* (derived from the Latin *immittere*, which means 'to send into') are air impurities, noises, tremors, light, warmth, beams, and similar environmental influences *impacting on* humans, animals, plants, soil, water, the atmosphere and cultural and other goods. *Emissionen* (derived from the Latin *emittere*, which means 'to send out') in turn denote air impurities, noises, tremors, light, warmth, beams, and similar phenomena *emanating from* a facility.

February 1995, there were 1,241 sites on the NPL; when the study described in this report was conducted, the NPL contained 1,191 sites.

To determine whether CERCLA's objectives (e.g., protection of human health and the environment and payment for harm by the polluter) are met, data on the results of cleanup actions (e.g., increased human health and environmental protection and costs for cleanup) are needed.

CERCLA Reauthorization

CERCLA is a law that requires reauthorization. Congress authorized the original law through 1985. In the mid-1980s, responding to administrative and implementation problems that resulted in a lack of substantial accomplishments in the first five years of the program, Congress spent several months developing reauthorization proposals. In its 1986 reauthorization, the Superfund Amendments and Reauthorization Act (SARA), Congress significantly strengthened and expanded the law. SARA stressed the use of permanent remedies and treatment over containment and institutional controls (e.g., zoning), added cleanup goals and standards, created new enforcement authorities and settlement tools to encourage responsible parties to conduct cleanups, required that other federal and state environmental laws be considered in determining final cleanup remedies, and added $8.5 billion to the $1.6 billion trust fund created by CERCLA in 1980. In 1990, through the Omnibus Budget Reconciliation Act, Congress reauthorized CERCLA again. However, other than authorizing an additional $5.2 billion for the fund and extending the taxing authority through the end of 1995, Congress made no substantive changes to SARA. Superfund was due for reauthorization again in 1994, and for more than two years, Congress held hearings to obtain information on the progress and problems of the law in order to make appropriate changes during the third reauthorization. However, the 103rd Congress failed to reauthorize CERCLA by the end of its term. The November 1994 elections changed the makeup of the Congress, and the new (104th) Congress is holding another round of hearings in anticipation of reauthorizing CERCLA during the current two-year term. As part of the reauthorization process, various interest groups provide information to members of Congress for consideration in developing new proposals. The administration may also submit its recommendations for improvement.

The interest in CERCLA reauthorization for this study stemmed from analyses conducted for the U.S. Department of Energy (DOE) with respect to the effects of CERCLA on domestic energy industries. Energy industries include petroleum refining, nuclear fuel processing, coal mining, and electricity generation. DOE needed the ability to provide input to the reauthorization process that would reflect the concerns of U.S. energy industries. Therefore, it required information on the effects of the existing law on those industries. For example, DOE needed to know the numbers of NPL sites in which energy industries were involved, either because an energy company was a potentially responsible party (PRP) or because an energy or energy-related activity occurred at the site. Other necessary information included cleanup costs for NPL sites with energy-industry involvement, economic liabilities of energy industries, geographical distribution of sites with energy-industry involvement, and nature of environmental contamination at energy-industry sites.

METHODOLOGY FOR ASSESSING ENERGY-INDUSTRY INVOLVEMENT

The approach for identifying energy-industry involvement at Superfund sites was relatively straightforward. However, for reasons described below, the initial approach failed to produce the required information and had to be revised.

Initial Approach

The initial approach had two phases. First, ANL sought to identify NPL sites with energy-industry involvement, so-called Energy-NPL sites (Phase 1). Second, ANL planned to collect information on costs, location, environmental media affected, and potential liability of PRPs for those Energy-NPL sites (Phase 2). For Phase 1, ANL used the three-step approach outlined below.

- Review EPA's Database of PRPs (Step 1). As part of the Superfund process, EPA sends letters to all PRPs notifying them of their potential liability, and in some cases requesting information. EPA's Site Enforcement Tracking System (SETS)[2] is an electronic database containing the names and addresses of PRPs to whom such notice letters have been sent. ANL obtained the most recent diskette version of SETS and conducted a keyword search on all PRPs and sites in the SETS database. Sample keywords included energy-related terms (e.g., "oil" and "electric") and energy company names (e.g., Texaco). This approach produced a list of roughly 100 sites with potential energy-industry involvement and the names of the energy-industry PRPs associated with those sites.

- Review Written Summaries of NPL Sites (Step 2). EPA also maintains a set of State Books[3] that contain two-to-three page summaries of information on individual NPL sites. This State Book information includes the kinds of activities that occurred at the site, progress in cleaning up the site, location of the site, and types of environmental media affected. We reviewed the most recent set of EPA State Books to identify additional Superfund sites that might not have been captured in the keyword search of SETS.

- Classify Energy-NPL Sites (Step 3). Based on the information from the above two sources, we distinguished the following three types of energy-industry involvement. Category 1 sites have some form of energy production or distribution as the primary site activity. Examples of Category 1 sites are coal gasification plants and oil refineries. Category 2 sites have some activity which, without being the primary or sole operation, is energy related. Examples of Category 2 sites include used-oil reprocessing facilities and landfills located on abandoned coal strip mines. Category 3 sites are those where energy-industry companies have been named as PRPs, but where the EPA State Books indicated no energy production or distribution activity. These sites are typically industrial or municipal waste disposal facilities.

Phase 2 data collection activities relied on two sources: the State Books and the Record of Decision (ROD) Annual Reports.[4] The ROD Annual Reports summarize information, including cost data, provided in individual site RODs. (A ROD is a public document prepared as a part of the cleanup process that explains which cleanup alternative(s) will be used to clean up a given NPL site.)

While collecting and reviewing the data during Phases 1 and 2, it became apparent that the approach was not as straightforward as had been anticipated. Each data source had problems that increased the data collection and analysis effort and limited the utility of the results. These data sources and their associated limitations are summarized below.

- SETS. The SETS electronic database contained only 706 (about 60 percent) of the then 1,191 sites on the NPL. It had no code to identify the types of industrial activity conducted at the sites, and thus, there was no automated way to determine whether a given company was an energy company or not. Duplicate and inconsistent reporting occurred for many sites, leading to potentially inflated PRP counts.

- State Books. The State Books suffered from insufficiently detailed narrative descriptions so that it was often impossible to determine if energy industries were involved and if so to what extent. Like SETS, they contained no code for identifying the types of activity conducted at a site. The data were often two years old. (Despite claims that the Superfund process is generally slow, cleanup progress at individual sites can change significantly in two years.) The hard copy format increased the effort significantly beyond what it would have been were the data in electronic format.

- ROD Annual Reports. The ROD Annual Reports contained incomplete cost estimates. Not all sites with cost data were in the report (because many RODs were completed after the most recent ROD Annual Report was published). Many sites had incomplete cost information (because not all of the required RODs for these sites had been completed). For a given site, costs could be reported in up to four different forms (capital, annual operating and maintenance, present worth, or some combination thereof). As a result, cost comparisons among sites were limited to those with the same form of cost reporting. There were no inflation adjustments, so that comparing estimates made in the early 1980s with those made in the 1990s, for example, may be misleading. Finally, in no cases were there data on the actual benefits expected from cleanup or on the gains in protection to human health and the environment, a key objective of the law.

Modified Approach

Because of the above data limitations, we had to modify the original approach in order to provide useful and accurate information on energy-sector involvement for the CERCLA reauthorization process. The modified approach entailed a number of unanticipated and time-consuming steps. First, we needed to identify additional data sources. These sources were not as readily accessible as the first three. In some cases, we had to compile the data based on individual conversations with project managers and other sources at nearly 100 NPL sites. Second, rather than simply reviewing data from existing databases, we had to create our own database of energy-sector NPL site information, the so-called Energy-NPL Database. The data collected in the modified approach came from the following four new sources:

- A Computer Printout of Site-Specific Cost Estimates Compiled by EPA's Office of Solid Waste and Emergency Response (OSWER). OSWER collects two types of cost information for various steps in the investigation and cleanup process at NPL sites: expected cleanup costs and costs reimbursed to or recovered by EPA. For each site in the printout,[5] the costs were reported by cleanup activity (e.g., feasibility study) and by type of enforcement action (e.g., consent decree). However, costs were not reported individually for each PRP. We manually reviewed the cost data for each site in the 350-page printout and summed the cost estimates for the individual site activities to obtain total per-site cleanup cost estimates.

- Federal Register Notices on NPL Sites. The Federal Register is a daily report that identifies and presents all regulations, policies, and related notices issued by federal agencies. One of the many items reported in the Federal Register is a periodic (at least twice a year) listing of sites on the NPL. We used this list to verify names and locations of the NPL sites.

- Volumetric Information Provided by Individual Project Managers. Because EPA is not required to collect, and individual companies are reluctant to divulge information on the costs they pay to clean up sites, PRP-specific cost data are difficult if not impossible to obtain. Lacking such cost data, we used a surrogate — shares of waste contributed by individual PRPs at a given site. This surrogate is frequently used by groups of responsible parties for allocating cleanup costs among themselves when individual contributions to harm cannot be determined. PRP groups, contractors, or attorneys have estimated individual volumetric waste share contributions for roughly 100 NPL sites. However, there is no central database of sites with volumetric information. Therefore, we had to identify those sites for which volumetric information, in the form of volumetric rankings or "waste-in lists," were conducted, and then try to obtain such rankings or lists. The effort entailed phone calls to nearly 100 individual project sites, and numerous follow-up activities (e.g., letters, freedom of information requests.) The resulting information varied in format, but basically each volumetric ranking listed the PRPs at the site and the share of waste contributed by each of those PRPs. At some sites, up to 2,500 PRPs were listed and frequently we had to calculate shares because the waste-in lists reported contributions in volumetric units (e.g., gallons) rather than percentages.

- Business Directories. We consulted several professional business directories[6] with information on the nature of business conducted by companies to determine whether certain PRPs (those with names indicating a possible energy-industry affiliation) were in fact energy-industry companies. We also used these directories to ascertain the relative financial strength of energy-industry companies for the purpose of testing the theory that EPA often targets large, financially strong companies (commonly known as "deep pockets") to pay for cleanup costs.

We reviewed data from the original and new sources, checked for duplication, reformatted data where necessary, developed numerical codes for descriptive information (e.g., type of energy industry activity), corrected inconsistencies, and calculated midpoints when only ranges of costs were provided. Based on the types of questions we sought to answer and the types of data now available, we designed a database management system to store, update, and retrieve those data. The system,

called the Energy-NPL Database, operates on a personal computer and uses Foxpro database software. It contains seven separate but electronically linked databases and roughly 21,000 records.

DATA RESULTS

Limitations in data coverage and quality combined with the conventions used in developing the database suggest that the following results should be viewed as general indicators and rough estimates rather than as absolute conclusions.

NPL Sites with Energy-Industry Involvement

The data indicated that one-fifth to one-third of the 1,191 NPL sites listed at the time of the study had some type of energy-industry involvement. We identified 266 sites (one-fifth of all sites) as having energy-industry involvement. (Extrapolating these results to compensate for the 40 percent shortfall in the SETS database yielded roughly 380 sites, or one-third of all sites.) Of the 266 identified sites, 32 were Category 1 sites, where the sole or primary activity was an energy operation, 108 were Category 2 sites, with some type of energy-related activity, and 126 were Category 3 sites, where, although there was no identifiable energy activity, one or more energy-industry companies were cited as PRPs.

Energy-Industry PRPs at NPL Sites

At the 266 NPL sites with energy-industry involvement, we identified roughly 950 energy companies as PRPs and an additional 400 possible energy-industry PRPs. Possible energy-industry PRPs are those with names indicating that they could be an energy company, but which could not be verified as such via the business directory searches. (Extrapolating these results to account for gaps in SETS and including the possible energy PRPs yielded an upper-bound estimate of 2,000 energy-industry PRPs.) In many cases, a PRP was cited at more than one NPL site, and hence, there is double counting in these estimates. Eliminating the double counting nets about 500 individual energy-industry companies involved at NPL sites.

Regional Distribution

For management purposes, EPA has divided the United States into 10 geographical regions, each containing between two and eight states. Environmental comparisons are often made on a regional rather than on a state basis. In general, the regional distribution of the Energy-NPL sites reflects the regional distribution of all NPL sites. There are two exceptions. First, in EPA's Region 6, which contains the oil-rich states of Texas, Louisiana, and Oklahoma, the percentage of Energy-NPL sites is greater than the percentage of all NPL sites (12 percent versus 6 percent.) Second, in EPA's Region 2 (New York and New Jersey), where there are high concentrations of chemical and industrial activity, the percentage of Energy-NPL sites is lower than the percentage of all NPL sites (11 percent

versus 17 percent.) This differential is reasonable, since chemical and industrial activities are frequently associated with Superfund sites.

Affected Environmental Resources

Just under 90 percent of the sites in the Energy-NPL Database have affected soils and sludges and ground water. Surface water is impacted at about 60 percent of the sites, and air at about 15 percent. Environmentally sensitive areas (e.g., wetlands) are affected at about one-third of the Energy-NPL sites. Specific information on the particular types of environmental problems associated with the threatened environmental media was not readily available.

Cleanup Status

Cleanup activities encompass several phases. First, site investigation studies determine the nature and extent of the potential damage. Later phases include initial actions, remedy selection, remedy design, cleanup, and finally completion. The entire process can take several years. All of the Energy-NPL sites have site studies that are planned, underway, or completed, but beyond these initial studies, the progress varies significantly. In general, progress at Category 1 sites lags behind that at Category 2 and Category 3 sites. The data do not suggest a reason for this trend. However, this trend implies that changes resulting from reauthorization could have a greater impact on energy-industry sites (Category 1) because with more stages in the process to complete, there are more opportunities for cleanup activities and requirements to be affected by changes in the law.

Site Cleanup Costs

Present-worth cost estimates as reported in the ROD Annual Reports are available for about half of the 266 sites in the Energy-NPL Database. (Present-worth estimates equal the amount of money, which, if invested in the first year and disbursed as needed, would cover all costs of the remedial action over its planned life.) Fewer sites have capital or operations and maintenance costs, and these costs are not easily compared with present-worth costs. The average present-worth cleanup cost estimate is $18 million, and the range is from $130,000 to $226,000,000. Costs tend to increase with decreasing energy-industry involvement. Thus, the average cleanup-cost estimate for Category 1 sites is about $10 million, and the average for Category 3 sites is $20 million. Of the 128 Energy-NPL sites with present-worth cost estimates, 15 are Category 1, 46 are Category 2, and 67 are Category 3. The sample sizes may be too small to afford much confidence in this trend. However, it is possible that the nature of waste activity at single-purpose sites (Category 1) may lead to less costly cleanups than at sites characterized by greater numbers of activities and PRPs (Category 3 sites).

Besides estimated present-worth costs, we also obtained cost data related to EPA enforcement actions. EPA has initiated such actions at over half of the Energy-NPL sites. Roughly 44 percent, or about $500 million of the roughly $1.2 billion in total costs recovered by (or reimbursed to) EPA, came from sites with energy-industry involvement. Of the total costs estimated to be paid through

enforcement actions (about $8.5 billion), just under one-third (about $2.7 billion) are attributable to Energy-NPL sites. The average amount recovered by EPA at Energy-NPL sites is about $3.5 million. The estimated enforcement costs for these sites average $14.5 million.

PROCESS RESULTS

Considering the resources available to conduct this task we believe that we obtained the most current and complete data available. However, the results could have been more robust had there been fewer inadequacies and gaps in the data. Better data and more specific findings would have facilitated development of a baseline against which reauthorization proposals could be compared and the assessment of Superfund's progress in meeting its objectives.

Data Deficiencies

Data deficiencies resulted in answers presented in ranges rather than point estimates, reduced confidence in findings, difficulties in comparing energy sector results with those of other industrial sectors, and problems in replicating the results.

Ranges in Findings. Our best estimate of the number of sites with energy-industry involvement is a range of 266 to 380, or roughly one-fifth to one-third of 1,191 NPL sites. Had the SETS database been complete, the estimate may have been more precise. Similarly, the ROD cost estimating guidance provided by EPA allows for an expected range of plus 50 percent to minus 30 percent. Thus, even if the $18 million dollar average per-site cleanup cost estimate were to reflect all of the costs of all the Energy-NPL sites (rather than only for the portions of the 128 sites for which some data were reported), this estimate could be anywhere from about $13 to $27 million per site. Ranges in numbers of sites compounded by ranges in average per-site costs imply that the actual expected costs for cleaning up the entire universe of Energy-NPL sites under the current law could vary significantly. Using the low and high ends of cleanup cost estimates produces a range of between $3.5 billion (266 sites times $13 million per site) and $10.3 billion (380 sites times $27 million per site), or a difference of nearly $7 billion dollars. This difference is just over the $6.3 billion estimated to have been paid by all private parties in Superfund cleanups during the first 12 years of the program.[7] Thus, while we can conclude that the current Superfund law imposes significant cleanup costs on energy industries, we cannot say how significant the impacts are. Such information would be useful input to the reauthorization debates, especially with the increasing Congressional interest in costs versus benefits.

Confidence in Findings. Data quality issues limit the confidence that can be placed in the results. For example, the data sources contain misspellings, duplication, and omissions with regard to energy-industry companies. Cost estimates do not reflect inflation. Many sites have no cost data and some have only partial cost data, and thus, some per-site estimates may under-represent the ultimate costs.

Comparison with Other Sectors The results cannot readily be compared with those for other industrial sectors. To make such comparisons, the same methodology would have to be used. However, collecting the same kinds of data for the remaining 800 to 900 nonenergy NPL sites would require significant additional resources. Thus, while the costs associated with cleaning up Energy-NPL sites are significant — on the order of $5 billion (266 Energy-NPL sites times $18 million average cleanup costs per site) — the utility of this finding would be enhanced if it could be compared with the cleanup costs for other sectors.

Ability to Duplicate. Individual data sources came from various EPA offices. Thus, inconsistencies and data gaps had to be addressed. We believe we used the most logical approaches for addressing these problems. However, other analysts could use alternative approaches for developing an Energy-NPL database. Hence, duplicating the database and verifying the results would be difficult.

Data Gaps

The lack of data on costs, allocation of harm, and benefits gained from cleanup makes it impossible to adequately assess how well CERCLA is meeting its goals of protecting human health and the environment and requiring that the polluter pays its fair share for the harm caused.

Assessing Full Costs of Superfund. The Superfund liability system, as interpreted by the U.S. courts, is one in which liability is retroactive, strict, and joint and several. Under retroactive liability, a party can be held liable for waste disposal actions that occurred prior to enactment of the law. With strict liability, PRPs can be held liable for problems caused by a hazardous substance release even if legal and acceptable waste management practices were used at the time of disposal. Joint and several liability means that in cases where environmental harm cannot be divided, each and every party, alone or in combination, can be held liable for 100 percent of site cleanup costs. PRPs that pay more than their share can sue other PRPs for contribution. As a result, the Superfund process has been criticized for spurring litigation and transaction costs. But these costs, and the economic costs of properties not sold and the costs incurred to prevent hazards due to concerns about potential Superfund liability, are not included in the available databases used in this study.

Matching of Responsibility with Costs Paid. Because there are no readily available data on the degree of responsibility for PRPs and the cleanup costs actually paid by these parties, it is impossible to determine the extent to which the polluter actually pays. Many lawyers, PRPs, and regulators who have been involved with CERCLA actions argue that the joint and several liability provisions of CERCLA make it easy, and in fact efficient for EPA, once it has established responsibility, to focus on large, financially viable companies — the so-called "deep pockets" — for conducting or paying for cleanup. Therefore, many PRPs and Superfund attorneys claim that large companies pay more than their fair share of Superfund cleanup costs. However, because the data on individual PRP responsibility and actual costs paid by identified parties are limited, it is difficult to support or refute

this claim. As a result, we are unable to assess whether a basic philosophy of the law — that the polluter must pay for his fair share of the harm — is actually met.

Information on Benefits Gained or Risks Reduced. Although the overall goal of the cleanup program is to protect human health and the environment, there are virtually no data to assess how well this goal is being met. While risk assessments are typically calculated prior to remedy selection, they only provide an indication of expected cancer risks. Few, if any, data exist on the actual number of lives saved, illnesses avoided, or ecosystems protected as a result of cleanup. Also, there are no data indicating the value of these benefits. Therefore, the costs of cleaning up specific hazardous waste sites are not easily compared with the benefits of cleaning up those sites.

IMPLICATIONS OF FINDINGS FOR REAUTHORIZATION

In developing the baseline for energy-industry involvement at Superfund sites, it became clear that because of data deficiencies and gaps, it would be impossible to adequately evaluate how well the goals and objectives of the Superfund law were being met. The law provides no systematic mechanism for evaluating its effectiveness in meeting the goals of protecting human health and the environment and requiring that the polluter pay for the harm caused at Superfund sites. Although we were able to collect enough data to provide a general baseline for assessing impacts of proposed changes to CERCLA on energy industries, better data could provide useful information for the reauthorization process. Two examples illustrate how such data could be useful.

First, reports indicate that after 14 years, fewer than 20 percent of the sites on the NPL have been cleaned up.[8] Many critics use this statistic as at least a partial justification for changing the Superfund program. But this statistic indicates nothing about the extent to which risks to human health and the environment at the site have actually been reduced. Many sites that are not officially "cleaned up" may have benefitted significantly from removal actions addressing major risks. The data on which the 20 percent assertion is based only reflect the stage within the cleanup process, which may have little relationship to the actual reduction in risk at that stage. It is not surprising that these risk reduction data do not exist. The legislation neither provides for nor even suggests that such information be tracked. Were these data available, lawmakers would have a better understanding of the success of the program in reducing overall risks at hazardous waste cleanup sites.

As a second example, we often hear that "deep pockets" pay more than their "fair share" of responsibility, a situation that contradicts the "polluter pays" principle. Without data on actual costs paid and degree of responsibility, we do not know the extent to which these claims are true. The Energy-NPL Database includes several energy-sector deep pockets with potentially enormous liabilities. One major oil company, for example, has been cited as a PRP at 29 individual NPL sites, six of which have present-worth cost estimates of more than $40 million per site. Because of joint and several liability, this company could conceivably be held liable for 100 percent of the cleanup costs at each site for which it has been listed as a PRP. The estimated costs for cleaning up 19 of the 29 sites for which cost estimates are available amount to over $750 million. However, the data do not indicate with satisfactory precision the actual costs paid by such PRPs, or the actual extent of

their responsibility. Again, this is not surprising, because the law does not require that cleanup costs be tracked. Without legislative goals that can be easily measured, individual PRPs may end up spending more than their fair share, thus potentially leading to a violation of the polluter pays principle.

Without good data, legislators may take subjective actions which, while intended to improve the program, may actually weaken the program, or focus on areas where benefits are small compared to the costs. For example, at a particular Superfund site, it is possible that costly "pump and treat" actions would be required to meet restrictive safe drinking water standards (because CERCLA requires that applicable state standards be met), even though studies have shown that such pump and treat techniques are largely ineffective.[9] Similarly, some entire sites may be remediated to pre-activity conditions, but because the resources to do so are significant, EPA can manage only a few sites at a time. As a result, other Superfund sites that may pose greater threats may not receive needed attention.

In general, priorities among broader environmental problems may be misallocated. In 1987, the EPA published a study that addressed the potential misallocation of resources among environmental programs.[10] As part of the study, a group of scientific experts evaluated 31 separate environmental problems in terms of cancer risks, non-cancer health risks, ecological effects, and welfare effects (e.g., visibility impairment.) Considering risks to the entire American population, the scientists found that, in general, the highest risks were associated with air pollutants. They ranked active and inactive hazardous waste sites, and municipal and industrial waste sites in the lower half — above pesticides, new toxic chemicals, and exposure to consumer products but below discharges to surface water and contaminated sludges. The report compared these rankings with those based on a survey of public perceptions of risk. The public ranked hazardous waste sites as the number one risk area. The study also found that EPA's program priorities appeared more closely aligned with public perceptions than with the scientifically estimated risks. Knowledge of the actual risks associated with hazardous waste sites would enable Congress to direct resources toward problems that pose the greatest threats to human health and the environment.

HAZARDOUS WASTE CLEANUP LEGISLATION IN OTHER COUNTRIES

Limited research into the hazardous waste cleanup programs in other countries provides two other models of potential interest to lawmakers seeking to enact hazardous waste cleanup legislation. These two examples come from Germany and the Netherlands.[11] Both of these countries are as highly industrialized as the United States but are more densely populated, and face similar problems associated with old hazardous waste sites. However, their hazardous waste programs differ significantly from the U.S. Superfund program.

Cleanup Programs in Germany

As of 1993, 48,000 inactive hazardous waste sites (*Altlasten*, literally, "old burdens") were registered in the old western states of Germany, and estimates reach as many as 70,000. Such sites in the eastern states may be countless, and it is expected that public monies will have to be used to clean

up those sites. Germany currently has no national statute addressing the cleanup of inactive hazardous waste sites. A centralized agency equipped with coercive tools comparable to EPA does not exist. Primary responsibility for operations relating to hazardous waste is placed at the state level. Local authorities rely on traditional police powers to avert dangers for public safety and order, which under the German constitution are state prerogatives. The police and safety authorities have discretion whether to proceed against the landowner, or if not the same party, the original polluter. The police order can vary from simply requiring fencing the property to forcing a complete remediation effort. Future land use is an important factor for determining the cleanup standard. If the responsible party does not act under the order and the authorities proceed with the cleanup, the government may seek cost recovery. The use of police and safety laws has been criticized for several reasons. Critics charge that the local authorities carrying out the laws may push toward low-cost containment remedies as opposed to permanent remediation. Further, in terms of the "polluter pays," it seems that the landowner (although potentially "innocent" of causing harm) is by far the most likely "polluter" approached for cleanup.

The Federation could use its "concurrent legislative powers" in the area of waste disposal to enact a national statute, but absent federal standards, procedures, and dedicated funds for cleanups, individual states are pursuing their own approaches. While some states, e.g., Bavaria, have experimented with cooperative agreements between governments and industry to clean up orphan sites, all states rely on some form of fee collected from producers of hazardous waste. There are no national data and few state data on the number of sites remediated by responsible parties.

A key factor in motivating voluntary cleanups of waste sites at currently operating facilities lies in the monetary value of the land at the sites. If the land value is much greater than the cost of the cleanup and promises profitable subsequent use, then the site is likely to be cleaned up.

The Dutch Cleanup Program

The Dutch program for cleanup of abandoned waste sites is primarily a public works program. Financed from current tax revenues, it has been criticized for its slow pace in light of the number of sites. Government-financed cleanups are supplemented by voluntary programs, such as the Soil Cleaning of Business Premises Currently in Use, known as "BSB" (*Bodemsanering van in Gebruik Zijnde Bedrijfsterreinen*), which involves a national agreement between the environmental ministry and several key industries. Businesses thus avoid litigation and work with flexible cleanup schedules and engineering techniques, and the government does not shoulder the entire cost burden. Voluntary cleanups by landowners seeking construction permits occur if the land value is high enough. Soil cleanup levels are based on the Dutch "ABC" (A for being clean and "multifunctional;" B for requiring investigation; and C for triggering remediation) system. This strict approach does not consider land use and results in difficult and expensive cleanups. However, municipal authorities have somewhat departed from the standards in order to spur cleanups and to address other local priorities (e.g., turn old industrial sites in the inner cities into locations for new housing construction). Furthermore, recent legislation provides for risk analysis, prioritization of cleanups, and consideration of how the land will be used.

Contrasts Between U.S. and European Programs

In Germany and the Netherlands, land value and land use are important factors to determine cleanup standards, or to motivate voluntary efforts. In the Untied States cleanups are driven by potential hazard to human health and the environment, as reflected in the NPL. It should be noted, however, that the success of the U.S. approach is difficult to measure, given the current structure of the law. A system where success relates to the number of sites returned to economic use or the dollar value of the restored economic activity of those sites may be more easily measured. The contrasts between the U.S. and European programs probably reflect differences in objectives more than differences in approach. However, Church and Nakamura[12] suggest that what appears to be a cooperative stance of European regulators, may simply be an acquiescence to the futility of trying to compel businesses to clean up through court action. They summarize the U.S. program as entailing high levels of acrimony, transaction costs, and delays, but resulting in cleaner sites at lower costs to the public. In contrast, the European programs are less acrimonious and litigious, but result in lower levels of cleanup and higher public costs.

RECOMMENDATIONS

The case study for developing a baseline of energy-industry involvement in Superfund combined with limited research into the hazardous waste cleanup laws of other countries, provides issues for policy makers to consider when developing or reauthorizing hazardous waste legislation.

Define Objectives and Goals

A first step in developing good hazardous waste legislation is to define the goals and objectives to be accomplished by that legislation. In developing these goals, lawmakers should consider the resources available to meet those goals. If the resources needed exceed the resources available, the program is not likely to succeed. As a corollary, lawmakers should address the question of "how clean is clean?" For example, will the objective be to restore the site to the conditions existing prior to the activities that produced the hazardous waste, will it be to reduce significant threats and put the sites back into restricted or unrestricted use, or will it be something else? Depending on the resources available, the goals and objectives may need to be modified. By identifying specific objectives in the context of available resources, both the regulated community and the regulators will be in a position to design cleanups that meet agreed-upon goals.

Include Measures for Success

Lawmakers should consider incorporating some ability to measure the success of the stated objectives of the program. Success indicators can be quantitative (e.g., percentage reductions in measures of ambient air quality). They can also be qualitative (e.g., Reports to Congress regarding implementation). For example, EPA must report to Congress on health risks remaining after installation of specific controls on toxic air emission controls, and make legislative recommendations.

If Congress does not act on the recommendations, EPA must issue health-based standards under provisions in the Clean Air Act. Requirements to measure success of a program can also be imposed on the states. For example, the Safe Drinking Water Act requires each state to establish a program to protect areas around public water system wells from contaminants that may have adverse health effects. If a state fails to establish the program, it can be denied federal implementation funds. Alternatively, a law can require testing by manufacturers and processors when insufficient data on environmental and health effects are available. Under the Toxic Substances Control Act, EPA can limit, ban or otherwise control manufacture, processing, distribution, use or disposal of chemicals until sufficient data are available to determine whether they can be approved for manufacture.

In providing for success measures, lawmakers must walk a fine line. They should ask for enough data to provide the necessary answers. However, they should avoid asking for so much data that the effort is seen as just a bureaucratic requirement imposing unnecessary costs and possibly encroaching upon confidentiality concerns without generating identifiable benefits. For example, Title III of CERCLA, also known as the Emergency Planning and Community-Right-To-Know Act, requires facilities to file reports on certain dangerous chemicals they handle or release into the environment. In 1994, EPA, which implements the requirements, doubled the list of chemicals for which industry must file reports. The addition of 286 new chemicals will cost an estimated $99 million in reporting the first year and $49 million each year thereafter.[13] Thus, the implications for data requests need to be identified and evaluated in terms of the expected benefits such data collection activities will provide.

Review Domestic Laws

Examining environmental laws that already exist can often indicate approaches that have worked and not worked. For example, the Clean Air Act of 1970 required EPA to set air quality standards for common and widespread pollutants. Based on data collected by EPA, an estimated 140 million Americans lived in areas that violated the ozone standard during the 1988-90 time period. Congress viewed this as unacceptable, and in the Clean Air Act Amendments of 1990 gave cities that violated the ozone air quality standard between three and twenty years to attain this standard, depending on the severity of the pollution. Thus, the original law provided for quantitative measures of success, and when they were not met, Congress was able to strengthen the law to address the problem.

When RCRA was reauthorized in 1984, data on the successes and costs of managing hazardous wastes were unavailable. As a result, Congress responded to public pressure to prevent the creation of future Superfund sites by significantly expanding the RCRA requirements. The reauthorized RCRA established over 70 statutory requirements including prohibiting land disposal of hazardous waste without approved treatment, establishing minimum technology requirements for land disposal facilities, requiring corrective action at sites to cleanup releases to the environment from waste management units, and expanding the universe of regulated sources. Many of these requirements are now being viewed as costly, confusing, and providing uncertain reductions in risk to human health and the environment.

Review Laws in Other Countries

Countries developing hazardous waste legislation may benefit from looking at the successes and failures of such laws in other countries. Such laws must be examined in the context of the goals and objectives, governmental structures, available resources, relative priorities, and public perceptions of the country that developed the law. The results should be compared with the particular agenda of the country planning to develop such legislation since the objectives and structures will differ from country to country. When comparing the successes of cleanup laws in different countries, there must be an appreciation of the objectives of the laws in the respective countries. A law is successful if it meets its objectives. For CERCLA, success relates to how well human health and the environment are protected, and the extent to which those who cause the harm pay for the associated cleanup. The number of sites "cleaned up" may be one measure of success, but for CERCLA, it should not be the only measure. Better measures would require collecting and analyzing data on costs, liabilities, and benefits. On the other hand, if the objectives differ, (e.g., an objective of the German program is to return sites to active economic use) the measures of success would also differ. In any case, measures of success must relate to the goals and objectives of the legislation.

SUMMARY

In developing hazardous waste cleanup legislation, policy makers should consider the goals and objectives of their individual countries, the viability of incorporating some measures of success into their legislation, and the possibility that periodic changes to the law to reflect changing circumstances, policies, resources, and objectives may need to be made. Policy makers can look to the successes and failures of legislation in countries with conditions and parameters similar to their own. They can then evaluate the effectiveness of such legislation given the circumstances in which the law is implemented.

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