Chapter 1

Summary, Introduction, and Policy Options

CONTENTS

Boxes

Figures

Tables

OVERVIEW

Superfund started out in 1980 as a short-term crash cleanup effort. By 1985, when Congress debated reauthorizing Superfund for a second 5 years, it had become controversial and confrontational. It has remained so. Superfund still lacks:

1. a carefully crafted strategy with implementation policies to spell out environmental priorities and goals;
2. an effective partnership among government, site communities, and private sector parties responsible for cleanup; and
3. a unified national infrastructure of education, training, databases, research, and development.

Superfund has not yet balanced protection of public health and environment against constraints of information, technology, time, and money very well.

Unless serious consideration is soon given to making **fundamental changes** in the structure and policies of the Superfund program through strategic initiatives, OTA's assessment is that significant risks to public health and environment will remain poorly managed, public expectations will remain unmet, and public confidence will worsen. Fine-tuning or incremental program changes are feasible and necessary too, but they alone will probably not suffice.

Another general OTA finding is that reducing excessive flexibility in Superfund implementation is critical to reducing the constant confrontation among nearly everyone affected by and working in the program. OTA calls the current adversarial condition the Superfund syndrome. Public fears of toxic waste and toxic chemicals set high expectations for Superfund; site communities perceive substantial risks to their health and environment and they want effective and stringent cleanups from the Environmental Protection Agency (EPA), regardless of cost; but communities have experienced slow, incomplete, and uncertain cleanups. EPA tries to limit fund-financed cleanups by getting parties held liable for sites to voluntarily pay for cleanups. However, responsible parties often believe that their liabilities are largely unfair, that risks are not as bad as communities think they are, that cleanup objectives are unnecessarily stringent, and, therefore, that they must work hard to minimize their cleanup costs. Unless everyone breaks out of the Superfund syndrome, most cleanups will seem to do too little or too much. Billions more dollars will be spent. Hardly anyone will be satisfied. Hardly anyone will feel treated fairly. Hardly anyone will seem in control.

Another general OTA finding is that Superfund's environmental mission is being undermined because of inefficient spending. OTA estimates that between 50 and 70 percent of spending by government and industry is inefficient because:

1. about 50 percent of cleanups address speculative future risks which preempts spending to identify and reduce current risks at many other sites;
2. about 75 percent of cleanups are unlikely to work over the long term; and
3. there are many unnecessarily high or avoidable administrative, study, and transaction (negotiation and litigation) costs.

OTA has found that many of the problems plaguing the Superfund program can be grouped in three areas: health and environmental protection priorities and goals; workers and technology; and government management. A three-point restructuring of the program focusing on these areas is possible. We summarize below our detailed findings in these areas. Later in this chapter, we discuss 38 policy options that, separately or in combination, Congress may wish to consider to improve the Superfund

program. There are so many options because the problems identified by OTA in Superfund implementation are numerous and complex. The 38 policy options have been divided into two categories: *strategic initiatives,* which would be major new directions in the program, any significant number of which would result in program restructuring; and *program changes,* which are more modest in scope and which could be integrated into the existing program. Table 1-1 lists the ***38*** options within the two categories and three problem areas.

Health and Environmental Priorities and Goals

Clearer priorities and less maneuvering room in environmental goals can make the Superfund system work better, fairer, and faster. By not setting clear priorities, government has fed unrealistic public expectations, making management of Superfund with limited resources a thankless task. Government has largely ignored the front-end of Superfund; for example, there is no Federal site discovery program. New National Priorities List (NPL) sites are no less hazardous than sites discovered earlier, according to EPA data. But sites in the program may wait years for significant attention. The size of the NPL is a policy choice, and cleanups are channeled from Superfund to other less stringent cleanup programs in the shadow of Superfund. Thus, Superfund may increasingly become a re-cleanup program.

A central conclusion of OTA's 1985 report ***Superfund*** *Strategy* was the critical need for taking faster, but *limited,* actions at *all* sites nationwide to reduce immediate threats and reduce the spread of contamination.[1] Today, the critical question is: Which expensive final cleanups are truly necessary ***now? The*** distinction between significant, current threats v. speculative, potential ones could be used to answer this tough question. Prudent use of the current-future risk distinction could get more sites into and through the system faster, at least through site stabilization to reduce current risks. Although, permanent cleanups would have to wait at sites where only future risks existed. The current large backlog of sites at the front and middle of the Superfund process could be traded for a backlog at the end, producing more rapid risk reduction for more people.

Workers and Technology

The relatively young and inexperienced national cleanup workforce requires better management, information, and technical assistance. Long-term government support is needed for basic research, R&D on critical problems, and education programs to improve and expand the national workforce. Frontline Superfund workers need more stringent policies on technology evaluation and selection, more information on what is and is not working in cleanups, and more access to technical experts. EPA needs more staff, to reduce its dependence on contractors, but it faces recruitment problems. The enormous potential size of the cleanup business has touched off a ferment of R&D and the emergence of hundreds of new companies with advanced cleanup technologies. But use of better, but often more expensive technologies, is limited by decisionmakers who are overly cautious, have poor information, or are primarily interested in minimizing front-end costs. It is equally important to recognize that some contamination problems do not yet have good solutions. For large contaminated aquifers, pumping and treating contaminated groundwater is less effective than previously believed. For large landfills, capping is an impermanent solution.

[1] And in subsequent, interim reports *Are We Cleaning Up? 10 Superfund Case Studies* (June 1988) and *Assessing Contractor Use in Superfund* (January 1989), as well as in testimony at a number of congressional hearings OTA identified many implementation problems, particularly at the front-end of the program. However, nearly all public attention on Superfund still pertains (o remedial cleanup and the backlog at the front-end of Superfund remains.

Table 1 -l—Policy Options

STRATEGIC INITIATIVES

Setting Cleanup Priorities and Goals

1. Set Priorities on Basis of Current or Future Risks
2. Establish a Federal Site Discovery Program
3. Use Environmental Criteria to Eliminate Sites at PA and S1 Screening Stages
4. Remove Range of Acceptable Risk Objectives
5. Establish National Minimum Cleanup Standards
6. Define and Limit Meaning of Permanent Cleanup

Developing Workers and Technologies

7. Reduce Dependency on Contractors, Expand EPA Workforce
8. Establish a Hierarchy of Cleanup Technologies and Methods
9. Restrict Use of Groundwater Cleanup Technology
10. Establish Generic Site Assistance Program, Including Expert Systems
11. Establish Technologies Assistance Program
12. Better Define Mission of SITE Technology Demonstration Program

Improving Government Management

13. Use Generic Site Classification
14. Limit Responsible Parties to Implementation of Remedies
15. Reexamine Financing and Enforcement of Liabilities to Improve Environmental Performance
16. Strengthen EPA Headquarters Direction and Oversight of Regional Implementation
17. Commit to a Permanent Superfund Program
18. Establish an All Inclusive List of Cleanup Sites in the United States
19. Begin Examination of Moving Superfund Implementation Outside of EPA

PROGRAM CHANGES

Setting Cleanup Priorities and Goals

20. Use Hazard Ranking System in More Limited Way
21. Reassess and Limit Use of Indicator Chemicals for Site Studies, Risk Assessments
22. Clarify and Strengthen Cost-Effectiveness Requirement for Remedy Selection, Reject Use of Cost-Benefit Analysis
23. Better Integrate Community Perspective Into Enforcement Site Decisions

Developing Workers and Technologies

24. Make Site Managers Responsible for Sites From the Front-End of the Program Through Final Disposition
25. Establish Program for Certified Public Environmental Auditors
26. Strengthen Effort to Offset Current Limitations of the Government and Contractor Workforce
27. Establish a Bureau of Mines Superfund Support Program
28. Establish a Superfund Support Program at the U.S. Geological Survey
29. Increase R& Depending, With Focus on Groundwater Cleanup

Improving Government Management

30. Combine Preliminary Assessment, Site Inspection, HRS Scoring, and Remedial Investigation Phases into Single Site Evaluation Program
31. Combine Removal and Remedial Programs Into Single Site Cleanup Program
32. Reexamine Current Statutorily Required Program Performance Schedules
33. For Records of Decision, Require a Statement of inconsistency for Selected Remedy
34. Reduce Need for Formal Regulatory Compliance for Onsite Cleanup
35. Establish a Formal Evaluation Program for Completed Site Cleanups and Long Term Ones in Progress
36. Establish Formal Measures of the Program's Environmental Progress
37. Address Conflicts of Interest Associated With Technology Selection
38. Reauthorize Superfund for 10 Years

Government Management

By clarifying statutory requirements and improving EPA's compliance with them, public policy, statutory requirements, regulations, funding, and program administration could work together with less confrontation and friction. Congress, EPA, and States can find common ground in providing protection of health and environment without threatening the public welfare economically. Many of EPA's actions, such as its interpretation of cost-effectiveness, seem inconsistent with statute. Many statutory provisions provide insufficient direction to EPA on how to resolve competing goals; for example, what is a permanent remedy and when does fund-balancing identify excessively costly fund-financed cleanups?

The tension between obtaining more cleanups and industry's interest in minimizing costs has not been resolved satisfactorily. Allowing responsible parties to conduct site investigations and feasibility studies, which guide cleanup decisions, poses a conflict of interest between minimizing costs and assuring effective protection; it gives an advantage to responsible parties over communities. Superfund site communities want as much influence as the companies found liable for cleanup costs.

Responsible parties are paying for over 50 percent of site studies and cleanups through voluntary settlements; EPA wants to increase this contribution. OTA's analysis shows, though, that many of those cleanups are less stringent than government-paid ones. In fiscal year 1988, for example, 75 percent of remedies based on land disposal were for enforcement Records of Decisions (RODS) which are likely to lead to responsible party cleanups; 78 percent of remedies based on waste destruction technology were for fund RODS, which are likely to lead to fund-financed cleanups. **These and other OTA findings show a pattern of EPA selecting less stringent cleanup technologies to obtain voluntary or negotiated settlements with responsible parties. Excessively flexible government policies and rules allow significantly different cleanups at similar sites.** But an affected community cares more about getting effective cleanups than whether the government or responsible parties pay.

Conclusion of This Report

The task facing Superfund is formidable—cleaning up over 1,200 toxic waste sites currently on the NPL as well as another 900 sites (EPA's estimate) to 9,000 sites (OTA's estimate) which could be added over the next 10 years+ specially in light of tight Federal budgets and shortages of technologies and experienced workers. Fortunately, though, opportunities exist for making both the strategic and incremental changes in the program that would allow it to fulfill its mission. Making Superfund a *permanent* program would be a logical first step in this effort because achieving complete, rapid, and permanent cleanups everywhere in a decade or two is impossible. Over many decades, spending by all parties on cleaning up toxic waste sites could total $500 billion, unless there are major technological innovations that bring the costs of permanent remedies down.

BACKGROUND

Key Superfund Questions

As the time approaches for Congress to reauthorize Superfund a second time, after a decade of experience, there is ample reason to ask: Can Superfund perform effectively—not perfectly-to address the environmental problem of uncontrolled toxic waste sites? Can we develop a strategy consistent with time, money, and technology constraints? Can Superfund earn public confidence? OTA's findings support positive, optimistic answers to these questions.

The Superfund system is complex (see box l-A) and it is easy to lose sight of the basic technical driving forces. Which sites require cleanup? How much cleanup is necessary? What cleanup technologies can do the job? The answers to these questions determine the human and financial resources and *time for cleanup.* But there are few unequivocal, scientific right or wrong answers for the Superfund program, and often few (if any) *precise* answers for individual contaminated sites much less for all sites. The need for judgment is constant. Consensus and trusted answers are scarce. Are procedures and systems for site evaluations as effective as they could be? If not, are sites being rejected which truly need attention? Yes, they are. Has the dilemma of spending a lot quickly on a few sites while many more sites wait long times been resolved? No, the backlog of sites waiting to be evaluated in a preliminary way remains substantial.

Bringing more sites into the program, following statutory cleanup standards, and using effective technology would require a lot more money. More payments by responsible parties seem necessary. But will more enforcement mean a faster, more complete national cleanup effort? Not necessarily. Determining who pays for cleanup and building a strong legal case takes time and the legal and administrative transaction costs are high. And building a successful legal case is not necessarily consis-

***Box** l-A-How Does Superfund Operate?*

The Superfund system is complex. Sites are identified and enter an inventory because they may require a cleanup. At this point, or at any time, a site may receive a **Removal Action** because of emergency conditions that require fast action or because the site could get a lot worse before a remedial cleanup could be implemented. (Most of SARA's requirements for remedial cleanups do not apply to removal actions, even though removal actions can cost several million dollars and resemble a cleanup.) In the preremedial process, sites receive a **Preliminary Assessment** (PA); some then go forward to a **Site Inspection (SI), with** some of those sites scored by the **Hazard Ranking System (HRS).** If the score is high enough, the site is placed on the **National Priorities List** (NPL) and becomes eligible for a remedial cleanup paid for by the government, if necessary, or by responsible parties identified as having contributed to creating the uncontrolled toxic waste site. Undercurrent procedures, only about 10 percent of sites which enter the system are likely to be placed on the NPL. Some States have their own lists of sites which require cleanup; **these often** contain sites not on the NPL.

NPL sites receive a **Remedial Investigation and Feasibility Study** (RIFS) to define contamination and environmental problems and to evaluate cleanup alternatives. The public is given an opportunity to comment on the RIFS and EPA's preferred cleanup alternative. Then, EPA issues a **Record of Decision** (ROD) which says what remedy the government has chosen and the reasons for doing so; the decision may be that no cleanup is necessary. A ROD may only deal with part of a site's cleanup and several RODS maybe necessary for a site. The ROD also contains a summary of EPA's responses to public comments. EPA chooses the cleanup goals and technology in the ROD. In actual fact a number of actions involving different technologies are likely to be chosen for any but the simplest sites. The ROD is like a contract in which the government makes a commitment to actions which will render the site safe. If responsible parties agree to clean up the site, they sign a negotiated consent decree with the government; this stipulates the exact details of how the responsible parties will proceed. If the cleanup uses Superfund money, the State must agree to pay 10 percent of the cleanup cost.

In the post-ROD process, the site receives a **Remedial Design** (RD) study to provide details on how the chosen remedy will be engineered and constructed. The whole process ends with the **Remedial Action (RA), the** actual implementation of the selected remedy. Many cleanups include long-term monitoring to determine whether the cleanup is effective and if more cleanup is necessary. A ROD may be reopened and amended because of new information discovered or difficulties encountered during the design and remedial action. When a cleanup is deemed complete and effective, the site can be delisted by EPA from the NPL.

SOURCE: U.S. Congress, Office of Technology Assessment, *Are* We *Cleaning Up? 10 Superfund Case Studies*, OTA-ITE-362 (Washington, DC: U.S. Government Printing Office, June 19ss).

tent with engineering a good cleanup solution. Obtaining settlements with responsible parties tests EPA's resistance to compromising environmental goals and incurs high oversight costs.

Even if we had enough money and technology, experienced and expert technical people in government and in the contracting pool are in short supply. Are special efforts needed to increase and strengthen the national cleanup workforce, especially at EPA where turnover is high? OTA's 1989 report on contractor use showed how important this problem is, and a number of the policy options in this report address this issue. In the short term, can we use information technology, special teams of experts, and stronger, central management controls to offset the limitations of a largely inexperienced workforce? In theory, yes, -but new programs must be created.

Public Demand for Cleanup

Without intense public demand for cleanup, there would be no Superfund program. But the general public and Superfund site communities, for the most part, have little confidence in the Superfund program.

As a new, large, technically complex program born in a crisis atmosphere in 1980, Superfund faced many difficulties under the pressure of high public expectations and intense fears about toxic waste. Public expectations have remained high. But the issue is not perfection. The public

wants open and honest communication and information, opportunities to participate, and environmental results. **The public is not the cause of Superfund's poor performance to date.** OTA's research finds that the government has not yet balanced necessary environmental goals with real world constraints of money, information, technology, and time.

Sometimes the public must be-and is—told that their expectations exceed technical or economic resources. The issue is the credibility of government reasons for ***not*** providing the most stringent cleanups. Should the community be content to wait for an indefinite period for reliable site information and for a complete, permanent cleanup? Or with full information, might the community consent to accept an interim action which greatly reduced immediate threats, even though that meant waiting for something more complete later on? Understanding this choice and participating in its resolution requires complete and timely information and participatory opportunities. The government has not yet achieved these routinely. **Sometimes the need and choice seems clear to the community and to others; it is the government that seems reluctant to do what is environmentally necessary and feasible.**

Regaining Public Confidence

How the government identities and communicates cleanup needs and solutions shapes public confidence. Superfund implementation needs commonsense practices. Analyses which make sense only to technical experts do not breed public confidence. When Superfund's managers depend solely on risk assessments, cost-benefit and other technical analyses to defend their policies and actions they do not succeed. Some Superfund managers do not speak in plain English. They justify their actions in terms of bureaucratic schedules and arcane regulations rather than environmental goals. Of course, within Superfund there *are* government people saying and doing the right things. But it is difficult for government workers to look (or feel) good when the public criticizes the program they work in.

What does a permanent cleanup mean to an ordinary person? It means that more studies, tests, and cleanup will not be needed, unless the most unexpected and unpredictable event occurs. In terms of safety, permanence means that people living near Superfund sites do not have to worry about exposure to toxic chemicals left in their community. People understand that some sites are very complicated and that new information obtained during the cleanup process may force significant changes. But people rightly lose confidence when they are told it is safe and effective to leave toxic waste in the ground and cover it up with soil, or to bury untreated toxic chemicals in a landfill, or to let groundwater slowly flush contaminants into a river.

Can a community accept a higher residual level of contamination compared to another community? Not if the real explanation seems to be who is paying for cleanup. People living near Superfund sites can understand that some legitimate technical factors (like a difference in route of exposure or the presence of a sensitive group of people or animal species) explain different cleanup standards. But understanding complex technical factors requires good information and effective dialog.

Do people who live near a Superfund site want their toxic waste shipped to a landfill in some other community? Based on what people have said during open discussions about remedy selection, for the most part the answer is no. When they do, they may be poorly informed about the feasibility and safety of onsite waste treatment, which the law prefers, but which may be under attack because of higher costs.

Lack of public confidence in Superfund and criticism of Superfund may cause some people to discount the real environmental problem and abandon the effort. **With billions of dollars at**

stake and widespread concern about competing environmental problems and harm to American industries, building public confidence in Superfund is more necessary than ever.

SUMMARY OF OTA'S FINDINGS

Superfund's primary purpose is not to punish guilty parties, not to sustain a cleanup industry, and not to respond to people's fears about toxic chemicals. Superfund's essential mission is to clean up land and water that are so contaminated that they constitute threats to human health and the environment. Therefore, OTA has examined Superfund from technical and environmental perspectives. However, OTA finds that the widespread interest in stronger enforcement to get more financing of cleanups by ' 'responsible parties' must be addressed because settlements with these parties are affecting some cleanup decisions adversely. Therefore, this dimension of the enforcement issue is important in this study.

There are three other chapters in this report and OTA urges the reader to examine them because only a small fraction of the detailed information and analysis in them t's given in chapter 1.

- Chapter 2 presents OTA's research results on the front-end stages of the Superfund system, starting with site discovery, including several levels of site screening and investigation, and ending with the listing of some sites on the National Priorities List (NPL). Even though the Superfund program has received so much attention, few people know much about the preremedial part of the program, yet it is critical to understanding the issue of setting priorities for the program and understanding potential resource needs.
- Chapter 3 covers cleanups and cleanup technologies. A number of key issues are examined, including the meaning of permanent cleanup and distinctions among different kinds of cleanup technologies, and obstacles to using new cleanup technology. There is also an extensive analysis of recent cleanup decisions which identifies the impact of settlements with responsible parties.
- Chapter 4 presents information on the whole national cleanup system and the many different cleanup programs in it, focusing on potential significant impacts on Superfund implementation and future resource needs.

General Conclusions

Accomplishments and startup problems notwithstanding, Superfund's overall poor performance is not a result of inadequate funding,[2] lack of cost-effective technology, inadequate legal authority for the government to get responsible parties to pay for cleanups, insufficient policy direction from Congress, or low public support. Superfund has not been neglected, ignored, or short-changed. OTA finds two root causes for Superfund's current low level of performance: 1) ineffective management of the Superfund program by EPA; and 2) unsuccessful congressional actions.

The closer one gets to Superfund's implementation the more that many cleanups look like decisionmaking has worked backwards, that is: 1) on the basis of some rough measures of the site's problem an amount of money for a site cleanup was determined, based on what responsible parties or the government were willing to spend; 2) some set of technologies and responses were chosen; 3) the combination of the first two determined the targeted level of cleanup. Of course this overstates and over simplifies the process. But money and bureau-

[2]The one exception was in fiscal year 1986 when delay of congressional reauthorization did have a significant disruptive impact on Superfund implementation.

cratic imperatives to show that something is being done seem to dominate Superfund, instead of independent scientific assessment of sites, cleanup objectives based on health or environmental effects, and engineering analysis of cleanup options.

This study has identified options for a three-point restructuring of Superfund:

1. **Health and Environmental Priorities and Goals:** Establish general and site priorities explicitly based on environmental goals so that money is spent to rapidly reduce the greatest and most imminent risks at the greatest number of places;[3]
2. **Workers and Technology:** Improve the quality of work and reduce costs by improving the government and contractor workforce and the technologies and procedures it works with; and
3. **Government Management:** Clarify statutory requirements and congressional intent and improve compliance with them by EPA policy and program management.

The 38 policy options presented in the last section of this chapter could be used to implement this restructuring, separately or in combination, if Congress chooses to do so.

Specific Problems and Findings

In each of the three areas described above, we identify first EPA's and then Congress' contribution to OTA's identification of particular problems. Then, we briefly discuss OTA's key findings.

Health and Environmental Priorities **and Goals**

Problem: Loss of the first priority, Superfund's environmental mission.

EPA—It has subordinated the environmental mission of the program to short-term fiscal and administrative objectives by, for example, limiting the number of sites placed on the National Priorities List and using an accounting approach to measure program performance instead of environmental accomplishments.

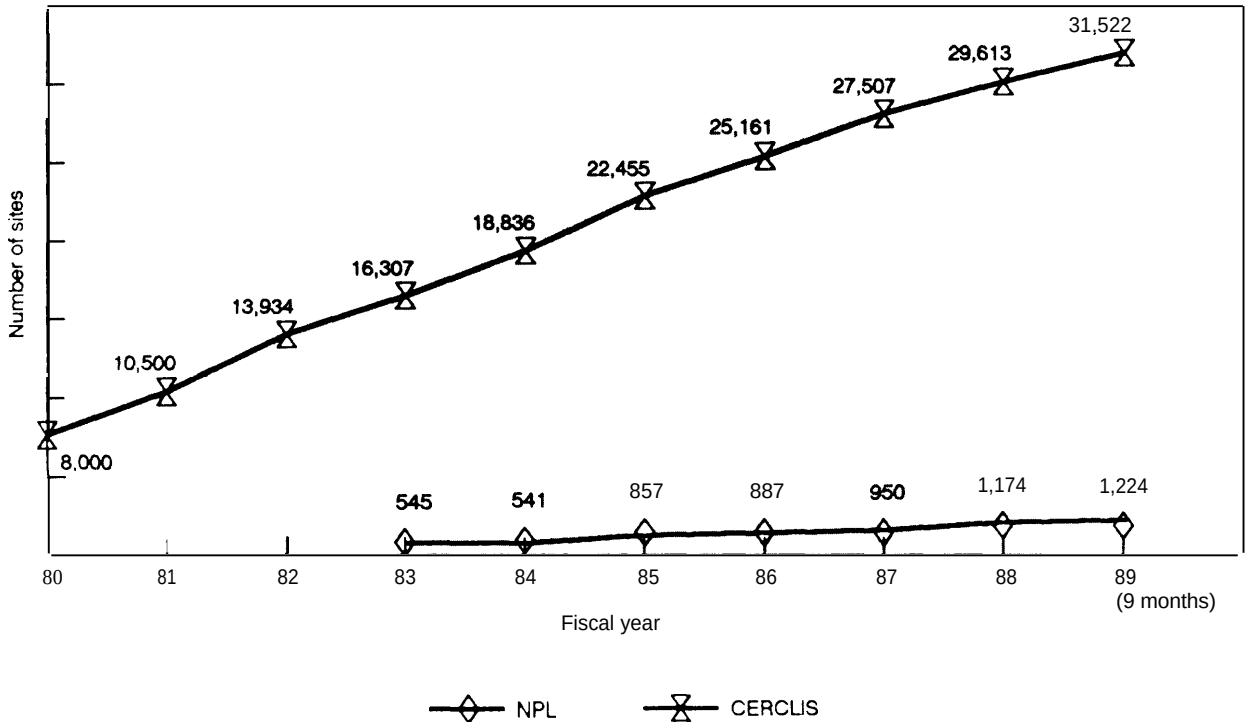
Congress—Some statutory directives have led to actions which are counterproductive to environmental goals---ego, non-environmental performance schedules—which drive EPA to an accounting measure of success. Such statutory requirements provide incentives to artificially shrink the size of the cleanup problem or to shorten and undermine the quality of studies.

OTA Findings—*Limiting program size through controlling site discovery.* Current EPA data on how many sites require cleanup under Superfund underestimate the true scope of the national problem. But, as figure 1-1 shows, looking at the past rate of increase in Superfund inventory sites and National Priorities List sites conveys a key message. Cleanup is a growth business. This is despite the fact that EPA has not carried out a comprehensive and systematic site discovery program nationwide, even though they have developed and, to some extent, verified such a program in a few parts of the country. Sites are also kept out of the inventory, because once in it, they must be processed within certain times.

Eliminating sites which really require cleanup. EPA's screening procedures for determining whether sites require remedial cleanup under Superfund incorrectly eliminate some sites which really do require cleanup. EPA has not estimated the magnitude of these false negative decisions, but OTA has. From 240 to 2,000 false negative decisions may exist. The criterion for deciding whether a site qualifies for detailed examination

[3]The Superfund Amendments and Reauthorization Act (SARA) of 1986 strengthened EPA's ability to perform limited cleanup actions under its removal program. But there is no evidence that the program has shifted its focus substantially to faster, partial remedies, even taking into account the use of operable units in the remedial program. Moreover, EPA current public discussions of setting priorities so that the worst sites get addressed first does not include consideration of carrying out site discovery, moving all sites entered into Superfund's inventory through preremedial evaluation quickly, or being concerned about incorrectly eliminating sites during preremedial evaluation which really require cleanup.

Figure 1-14 ERCLIS Inventory and National Priorities List Sites



SOURCE Office of Technology Assessment, 1989.

has changed significantly. Originally, there was a strict, but simple environmental criterion applied at the earliest screening stage (the Preliminary Assessment): Does it look like the site may require cleanup? Lately, the criterion has changed to: Is the site contaminated bad *enough* to warrant cleanup under Superfund? Indeed, the Hazard Ranking System (HRS) was originally applied as the third and last screening step. Now, the HRS is applied at the beginning of the preremedial process when information about a site is weakest. The question should nor be: Do we know enough to keep the site in Superfund? And, the response should not be to eliminate it if we do not. The question should be: Do we know enough to eliminate it from Superfund? And, the response should be to keep it in if we do not. The percent of inventory sites examined in the preremedial process that made it to the National priorities List sites started out at over 20 percent, decreased in the past few years to less than 10 percent, and must decrease further if EPA is not to exceed its estimate of a 2,100 site NPL by the year 2000.[4] A different *choice is* possible. **With site discovery, with improved procedures for examining and selecting sites, and without massive deferral of cleanups to other programs, particularly State programs, the NPL could ultimately reach 10,000 sites or more, conceivably by the year 2000 with a full-throttle effort. The size of the NPL is a policy choice which controls the distribution of cleanups among Superfund and other cleanup programs.**

[4]Many inventory sites, however, receive removal actions prior to or instead of placement on the NPL. However, there is little public accountability for removal actions and EPA now defers them to responsible parties and State and local government agencies before it considers performing them.

Problem: Luck of setting clear, environmentally based program priorities.

EPA—It has not made sharp enough distinctions between sites that really require major cleanup in the near term and those that can wait, nor has it used alternatives to actions that cannot provide permanent, cost-effective cleanups. There is too much bureaucratic separation between preremedial and remedial activities.

Congress—It has not adequately established program priorities. Conflicting goals have often been compromised as EPA tries to do a little bit toward meeting them all.

OTA Findings—Permanent *clogged preremedial pipeline.* **Under current procedures, the program will never eliminate its large backlog of unassessed sites which still require a Site Inspection and possibly application of the HRS.** For example, it could take 10 years to move all currently known sites through the preremedial stages and then there would be another 10 years of backlogged sites because of newly discovered sites. At times it has been suggested that the backlog is not that significant because the Nation's worst sites have already been identified and are on the NPL.

However, **OTA's analysis of HRS site scores shows that newly identified Superfund sites pose about the same level of environmental threat as older ones.** Letting sites wait for years before they receive significant examination and attention, therefore, can be a serious problem. To illustrate current delays, OTA examined the 229 June 1988 additions to the NPL; from the time of initial site discovery, one-third of sites waited 8 years or more, one-third waited between 4 and 7 years, and one-third waited 3 years or less to get proposed for the NPL. Analysis of the 47 April 1989 additions to EPA's site inventory database (i.e., sites with completed site inspections) found that, from the time of initial site discovery, over 50 percent of sites waited 8 years or more while fewer than 20 percent waited 3 years or less.

All risks considered equal when they are not, With few exceptions, EPA has not made a distinction between estimated risks which are real and current versus those which are more speculative and contingent on uncertain future uses of contaminated land or water or uncertain migration of contaminants. If it did so, EPA would have an important way to establish priorities and postpone major spending. (However, this would complicate attempts to get voluntary settlements with responsible parties.)

From examining several hundred cleanup decisions over several years, OTA concluded that as many as 50 percent of cleanup decisions (some sites have more than one) addressed future, uncertain risks. Confirmation of this observation comes from a study by Oak Ridge National Laboratory; it found that two-thirds of groundwater cleanups and one-third of soil cleanups were for sites without current risks (considering both cleanup categories, the average was 50 percent cleanups for sites without current risk).[5] At the same time, EPA has implicitly or explicitly deferred actions at sites that pose significant, more certain, and nearer term risks.[6]

There are limits to speeding up cleanups, but room for improvement. Detailed data on how a

[5] C.B. Doty and C.C. Travis, "The Superfund Remedial Action Decision Process' draft, undated; received by OTA on May 30, 1989; 50 out of 74 fiscal year 1987 RODS were examined; this is the same set of RODS from which OTA selected 6 positive and 10 negative examples for its June 1988 report. (Released as ORNL/M-780, September 1989)

[6] The following conclusion supports the importance of this issue and this finding: "The most important policy need is to develop realistic criteria for making remediation decisions. We need to find a balance between technical and economic criteria, identify statutory constraints on what remedies can be implemented and what cleanup standards, if any, limit the selection of remedies, . . .[G]reater attention should be focused on developing criteria to guide the decisions concerning whether to undertake remediation and when to stop remediation." Glen D. Anderson, *What Needs To Be Done' A Policy Perspective on Ground Water and Soil Remediation*, presented at Researching Ground Water and Soil Contamination: Are Science, Policy, and Public Perception Compatible?—a colloquium by the National Research Council, March 1989, Washington, DC.

site moves through the entire Superfund system (given in OTA's 1988 report) show that between 4 and 5 years pass from when a site is first identified until the Remedial Investigation and Feasibility Study at a site is started; a complete cleanup can take 10 years or more. But very fast complete cleanups at complex sites would often be inconsistent with technically sound cleanups. No one should underestimate the technical difficulties in fully understanding a site's problem(s) and selecting a cleanup remedy.[7] However, a major way to speed up overall protection of health and environment is to move sites through the early stages of Superfund faster. And EPA's preference for eliminating sites from Superfund, incomplete and impermanent cleanups, and unstringent cleanup standards help produce statistical progress instead of measured environmental performance. No good measures of environmental performance either at the site or program level are currently used.

Other cleanup programs exist but offer less stringency. A myth has developed that Superfund is *the* national cleanup program for toxic waste and other types of chemically contaminated sites. It is not. Superfund is just the visible tip of an expanding national pyramid of cleanup programs. All cleanup programs draw on the same national workforce and technologies. Some of the most important aspects of Superfund are missing in other cleanup programs; for example, in other cleanup efforts there typically is no preference for permanent cleanups, less opportunity for effective public participation in the entire cleanup process, less attention to all significant risks to both health and environment, and less public accountability.

Implementation of other cleanup programs are ***uncertain.*** **By** ignoring site discovery and controlling the preremedial process and the size of the NPL, EPA diverts increasingly more removals and remedial cleanups to other programs, especially to State programs. But few States have effective cleanup programs. Current information indicates that State programs rely extensively on land disposal and containment remedies, which ultimately will prove to be impermanent.

Information on several major State programs (e.g., California, Minnesota, and New York) indicate that about 80 percent of cleanups, not counting groundwater cleanup, bury or cover hazardous site material already buried, compared to 26 percent for Superfund's remedial program. However, the figure for land disposal and containment is close to 90 percent for Superfund's removal program, in which smaller, more urgent actions are taken (one-third are classic emergency responses). In other words, State cleanups are more like smaller Superfund removal actions (both are likely to cost several hundred thousand dollars, rather than tens of millions of dollars for remedial cleanups). See box 1-B for an example of a State cleanup which is inconsistent with current Superfund practice.

Because Superfund is the most stringent cleanup program, there is more and more shopping around for alternatives to Superfund. The flight from Superfund can be viewed as a significant national problem to the extent that cleanups outside of Superfund are less comprehensive, effective, or permanent environmental solutions. **Ironically, Superfund may increasingly be required to fix poor cleanups of the past from other programs, just as it was originally conceived to address poor past waste disposal practices.**

[7] Experienced Superfund contractor professionals have observed: "Using current site investigation and remediation technologies, it is not possible to locate all significant contamination, nor can anyone accurately predict contaminant movement, fate, exposure, effects, or remedial technology performance." William A. Wallace and David R. Lincoln, *How Scientists Make Decisions About Groundwater and Soil Remediation*, paper presented at Remediating Ground Water and Soil Contamination: Are Science, Policy, and Public Perception Compatible?—a colloquium of the National Research Council, April 1989, Washington, DC.

Box l-B—How a State Cleanup Can Differ Substantially From a Superfund Cleanup

In May 1989, the Minnesota Pollution Control Agency released its proposed cleanup plan for the Ashland Oil site in Cottage Grove. **As an** industrial site where a variety of wastes were land disposed, the site is typical of many Superfund sites. At the request of the State, the responsible party conducted the Remedial Investigation and Feasibility Study, and it has indicated that it will implement the cleanup. It took about 5 years to reach the site study stage, after the site was first identified as possibly requiring cleanup. Different levels of soil contamination, low levels of groundwater contamination, and buried drums were found. Contaminants include various asphalt and oil wastes as well as some volatile organic chemicals. Ten cleanup alternatives were examined, including no action. The cleanup plan selected by the State has three components: 1) offsite disposal of excavated drums; 2) excavation and consolidation of contaminated soils under a hazardous waste cap onsite; and 3) regular groundwater monitoring to detect any significant increase in contamination. The cost of the selected remedy is estimated at $500,000.

The Minnesota cleanup program has generally received high marks and a lot of attention because it emphasizes settlements with responsible parties. This cleanup seems representative of others in Minnesota and other States. Compared to Superfund, however, a number of concerns can be raised:

. Not one of the cleanup alternatives considered involved the use of treatment technology to permanently destroy hazardous material, unlike normal Superfund practice for a feasibility study. The type of chemical contamination at the site could be so treated.
• The selected ***remedy is based on OffSite and onsite*** land disposal, the least preferred type of Superfund remedy. The Superfund preference for a permanent remedy was not met. The source of potential increased contamination of the groundwater, for the most part, remains onsite. No hazardous waste landfill liner was selected, which would offer another level of protection against migration of buried contaminants into groundwater.
. The proposed remedy plan does not tell the public of any specific risks to health or environment posed by the site, nor any specific cleanup standards, unlike normal Superfund practice. It does acknowledge a current (pre-cleanup) risk as human skin exposure for people entering the site without protective clothing. Them is uncertainty about what level of detected increases in groundwater contamination would trigger further cleanup action.

This example shows that successful settlements with responsible parties for State cleanups, like some Superfund sites, can result in cleanups which are inconsistent with Superfund goals and requirements. Cleanup of this site under current Superfund rules, without the influence of settlement, would have likely involved substantial use of onsite treatment, such as incineration, increasing the cost to several million dollars. Even with a land disposal approach, cleanup under Superfund would probably have required a hazardous waste landfill liner, especially because of the evidence of groundwater contamination and because the site is along the Mississippi River. This would have increased the cost significantly. In fact, this site was scored with EPA's Hazard Ranking System and was scored high enough to qualify for placement on the National Priorities List. But many States retain sites for their own cleanup programs.

Workers and Technology

Problem: Decentralized decisions by an inexperienced workforce.

EPA--Superfund's managers have not effectively addressed organizational and workforce problems, such as the need to closely monitor activities by 10 EPA regional offices and to provide a young, inexperienced government and contractor workforce with better information and technical assistance, more explicit policies, and closer supervision.

Congress—It has appropriated enormous amounts of money quickly and put many pressures on EPA to spend that money. There has been little anticipatory concern about inefficient implementation resulting from excessive demand for contractors, technical information and methodologies, and cleanup technologies.

OTA Findings—Regionalized management. Demand has outstripped the ability of government to respond efficiently, especially in EPA's 10 regions. EPA Regional Administrators have

been granted extraordinary autonomy to implement Superfund. **EPA headquarters has done little to assure that regional cleanup decisions meet high standards and are consistent on key issues like cleanup goals and technologies.** Nor do EPA regions learn effectively from each other's experiences, both positive and negative. Regionalized management has also stood in the way of developing effective national databases and developing major support from key Federal technical agencies.

[nexperienced Superfund workforce. The Superfund workforce in EPA, States, and contractors has been given enormous responsibilities in a high-pressure environment that demands quick solutions to new and complex technical problems. But as already noted, the Superfund workforce is largely inexperienced, untrained, and poorly supervised. There is insufficient technical oversight of critical studies, analyses, and decisions. There is insufficient access to and use of the latest, reliable information on cleanup technologies and past cleanup failures and successes.[8]

Poor site studies and questionable cleanup decisions. The costly and lengthy studies of site problems—a scientific pursuit of knowledge—and cleanup alternatives—an engineering analysis on how to construct a remedy—all too often are riddled with inaccurate and incomplete technical information and analyses (see OTA's 1988 study). Poor studies help to explain why the government does not routinely select the most advanced, permanent, and cost-effective cleanup technologies. EPA's data on remedy selection, for example, show that in fiscal year 1987 and fiscal year 1988 only about 25 percent of source control RODS chose permanent remedies, using OTA's criterion of destruction or recovery of hazardous material. The Oak Ridge National Laboratory study mentioned above concluded that 19 percent of remedy selections could be interpreted to offer a permanent remedy; it also found that nearly 50 percent of soil cleanup decisions lacked specific cleanup goals and that RODS and backup studies do not provide discussions or rationales to support the selection of remedy based on a cost-effectiveness criterion.

Heavy use of contractors. Nearly all Superfund activities are performed by contractors, including some that should not be, such as policy-related work (see OTA's exert enormous influence over Superfund policies and programs, because government depends on them not merely for carrying out engineering and construction, but for the core technical expertise, information, and analysis which form the backbone of Superfund policies, programs, and decisions. Contractors frequently work both for the government and for companies the government is regulating and trying to get to pay for cleanups.

High spending levels cause inefficiency. The rapid demand for Superfund contractor services has been caused by the rapid escalation of spending demanded by many groups and provided by Congress. Moreover, at the same time, other cleanup programs have also geared up. The result is predicted by classic economics. Excessive demand creates a market which provides easy entry for inexperienced firms and too many jobs for inexperienced people as older companies expand. This contributes to low productivities and efficiencies, and it causes widespread and rapid turnover of the relatively few experienced workers and escalation of

[8] An important observation about the workforce problem and environmental performance has been made by an experienced environmental professional: "The Superfund program suffers from a combination of a shortage of human resources and extraordinarily stringent environmental objectives. On the one hand the nation is faced with a shortage of trained and experienced environmental scientists capable of evaluating complex risk and exposure models at Superfund sites. On the other hand, the system has delegated to these same overworked and relatively inexperienced people the responsibility for making risk balancing decisions which the [EPA] Administrator has frequently been unable or unwilling to make. Walter C. Barber, *Environmental Legislation and Regulatory Practice*, paper prepared for Environmental Quality and Industrial Competitiveness workshop, American Academy of Environmental Engineers, April 1989, Baltimore.

salaries. Expertise has been drained away from government to higher paying industry jobs. Currently, the government provides too few incentives for quality work, too little management control and auditing of contractors, and too little attention to layers of contractors and subcontractors with high overhead costs.

Government Management

Problem: Conflicts between the statute and its administration.

EPA—The agency often seems ambivalent about implementing statutory policies and directives, such as the goal of minimizing impermanent remedies based on containment and land disposal, and making technical assistance grants to communities. Interpretations which are inconsistent with congressional intent are a problem, such as converting cost-effectiveness into cost-benefit decisionmaking.

Congress—Some statutory provisions lack clarity, especially on resolving competition among objectives, or provide what gives, in retrospect, too much flexibility to EPA—such as the preference for permanent remedies which does not define what permanent means nor which treatment technologies are preferred.

OTA Findings—Mixed *results from the removal program.* Most actions are sound emergency and site stabilization responses to immediate threats, but some large removals circumvent statutory requirements for remedial cleanups. Removals frequently use offsite land disposal. EPA frost tries to defer actions to responsible parties and States. There is little easily accessible public information on removal actions. EPA's Inspector General recently reported not being able to find valid documentation for ***30*** percent of removal activities in Regions' files.[9]

Key *remedial cleanup decisions inconsistent with statute.* With too few exceptions, EPA's key remedial cleanup decisions—Records of Decision (RODs) are inconsistent with statutory requirements. They often are assertions or expectations instead of closely reasoned decisions supported by data and thorough analysis. Various kinds of environmental risks may be ignored or discounted. Consequently, it is not clear how the cleanups will be implemented or how effective they will be. Descriptions of decisions and remedies are frequently misleading (see OTA's 1988 report). For example, a ROD might say a cleanup is permanent, even though the cleanup relies on land disposal, or uncertain institutional measures such as deed restriction on future land use, or the uncertain outcomes of future tests, studies, and monitoring. The study by Oak Ridge National Laboratory mentioned above found that 68 percent of final remedial RODS required additional studies to confirm the extent of contamination, effectiveness of a technology, or applicability of the selected remedy to the site conditions. A ROD might say treatment technology will be used, when in fact land disposal will be used for most or much of the sites contaminants. For example, the cleanup at the Brown Wood Preserving site in Florida consisted of sending 94 percent of the carcinogenic contaminants to a landfill in Alabama, leaving 6 percent for a biological onsite treatment whose effectiveness is uncertain.

The cost-effectiveness criterion turned into cost-benefit. Everyone knows that cleanup cost has to be considered. However, EPA has transformed the statutory directive to minimize cost, after cleanup objectives are identified, into a cost-benefit approach which can reduce cleanup objectives to reduce cleanup cost. **Cost-benefit thinking allows nearly any kind of cleanup decision to be rationalized and undermines the environmental goals of Superfund. Cost-benefit reasoning backs up the selection of impermanent remedies because of excessive**

[9]U.S. Environmental Protection Agency, *Progress Toward Implementing Superfund—Fiscal Year 1987-Report to Congress,* April 1989.

flexibility in cleanup goals. RODS compare cleanup alternatives which do not offer comparable environmental protection and, on the basis of cost-benefit analysis, select low-cost remedies because a judgment has been made that they provide enough of a cleanup.[10] Communities often want more environmentally stringent remedies which, however, cost more money than the ones preferred by EPA, States, and responsible parties.

Problem: Conflict between enforcement and environmental protection.

EPA—It has not emphasized using the strong enforcement tools provided by statute and, therefore, has relied on making voluntary or negotiated settlements with responsible parties which sometimes are less stringent and less costly than fund-financed cleanups at sites where settlement is not feasible.

Congress-Congress has paid little attention to the intrinsic conflict of interest EPA faces as it pursues enforcement and settlement (to minimize cleanups paid for by the trust fund) while trying to uphold its environmental mission and adhere to strict statutory environmental provisions.[11]

OTA Findings-Cleanup decisions affected by desire for settlement with responsible parties. The selection of remedy as embodied in the ROD should be, but often is not, disconnected from enforcement and funding considerations .12 For example, RODS from the enforcement division show substantially greater use of containment and less use of permanent treatment remedies than do RODS from the fund financed part of the program. In fiscal year 1988, 14 percent of enforcement RODS (backed up by responsible party studies) selected treatment technologies which permanently destroy toxic waste (chiefly incineration and biological treatment); 44 percent of fund-financed studies and RODS selected destruction technology. Cleanup standards at sites where settlement with responsible parties is a factor are frequently substantially less stringent than at sites with fund-fina.need cleanups. An extreme example is for two similar wood preserving sites, one in Florida and one in Maryland. The cleanup standard agreed to for the enforcement site in Florida was 100 times higher (i.e., less stringent) than the standard for the fund site in Maryland. Based on its analysis of fiscal year

---

[10]The Oak Ridge National Laboratory study mentioned above found that 34 percent of RODS selected either no action or the least cost alternative *other than* no action; only *8* percent selected the most costly remedy. OTA's June 1988 report said ''The average estimated cost of the cleanups in the six good RODS. . was $20 million. In contrast, the average estimated cost of not-so-good cleanups in the 10 case studies. . was $12 million.

[11]This observation supports this perspective: ''*In* some respects, Congress has never explicitly resolved the policy issue as to whether the Superfund program is basically a public works program (through the Fund-financed cleanups), a public health program, or a regulatory/enforcement program, though SARA tips the balance more toward the latter. A consequence of a regulatory/enforcement focus is the demand for technical information you can go into court with, thus leading to more intensive site studies to provide 'enforcement quality' data. . . this may be one of the root causes, at least from a policy perspective, for the slow progress toward actual cleanups. ' Glenn Paulson, *Tools and Resources Available Policy Issues*, paper presented at Remediating Ground Water and Soil Contamination: Are Science, Policy, and Public Perception Compatible?—a colloquium of the National Research Council, April 1989, Washington, DC.

[12]A recent public statement of this problem was: ' 'The problem arises precisely because the risk assessment model has resulted in a further downturn in the Superfund program credibility with waste site communities, which cumulatively include millions of Americans. .[T]hese fears boil down to a conviction that the government is more interested in justifying partial cleanups which do not offend the pocketbooks of industry than it is in having an honest dialogue with affected citizens. " Rena I. Steinzor, *Decisions Based* on ***Public Policies*** and ***Perceptions***, paper presented at Remediating Ground Water and Soil Contamination: Are Science, Policy, and Public Perception Compatible?—a colloquium of the National Research Council, April 1989, Washington, DC. A study of EPA RODS noted that how closely a cleanup approaches legal mandates can be influenced by responsible parties: ''when the PRP [potentially responsible party] plays an active role (provided that public acceptance is possible), the EPA may be willing to negotiate and accommodate. Negotiation allows the EPA to gain PRP participation and financial resources where the alternative would likely be *litigation*. ,. . *'clean'* becomes whatever can be done at a reasonable cost with the technology available and that will be accepted by the public. ' C.F. Baes III and G. Marland, Evaluation of Cleanup Levels for Remedial Action at CERCLA Sites Based on a Review of EPA Records of Decision, Oak Ridge National Laboratory, January 1989.

1988 RODS, OTA concludes that responsible parties may eventually save as much as 50 percent or as much as $1 billion for those actions, compared to more stringent remedies.

With settlements and consent decrees, much can happen after a ROD is issued. For the Rose Township site in Michigan, EPA changed the selected remedy after the ROD in order to obtain a settlement with responsible parties. The change will reduce the cleanup cost by $19 million to $24 million. However, in EPA's proposed settlement plan and explanation of significant differences it did not inform the public that the settlement involved more than replacing some incineration of contaminated soil with soil flushing to remove volatile organic chemicals. (Soil flushing had been considered originally by EPA but not selected.) In fact, a stringent numerical cleanup goal in the original ROD was dropped and the consent decree allows the responsible parties to propose cleanup standards during the implementation of the cleanup.

Several conflicts of interest risk the environmental performance of Superfund actions. Responsible parties have a conflict between minimizing their costs and providing the public with environmental protection. In accordance with the basic congressional strategy of restricting fund-financed cleanups, EPA has decided to emphasize the tactic of shifting workloads and decisions to responsible parties. But letting responsible parties exercise control over the definition of contamination problems, the selection of remedies, and the implementation of remedies requires closer, effective government oversight. Increasingly, there is also a conflict between a responsible party using its own cleanup technology or business versus someone else's technology or services that might be more effective environmentally.

THE BACKGROUND FOR PUBLIC POLICY DEVELOPMENT

Breaking Out of the Superfund Syndrome

After examining Superfund implementation since its beginning, OTA has found it instructive to define a condition it calls the "Superfund syndrome' which can help us understand perceptions and problems of this program, as well as the adversarial nature of Superfund implementation. A syndrome is a set of complex symptoms of an undesirable condition. For Superfund, the undesirable condition is constant confrontation among nearly everyone affected by and working in the program. Mutually reinforcing but opposing values, interests, and objectives make program management and program improvements exceedingly difficult. For example, there are community-government disputes over technical issues and cleanup objectives; there are responsible party-government disputes about technical issues and cleanup costs. The Superfund syndrome forestalls consensus on identifying key issues and resolving them. "Analysis breeds paralysis" as stakeholders with different perceptions of risk and different priorities fight data with data. Contractors keep busy, reports pile up, contamination spreads into soil and groundwater, many sites wait to get into the system. It is very difficult to break gridlock situations by invoking explicit policy direction, and litigation waits in the shadows. The syndrome slows improving program effectiveness and efficiency through upward movement on a learning curve.

OTA has identified two causes of the syndrome: 1) opposing views of risks to public health and environment and, therefore, of necessary cleanup costs; and 2) excessive flexibility in the statutory structure and implementation policies of the program. The first factor has no near-term solution, but the second cause does. The result of these two factors is a system in which competing interests find too many opportunities to achieve their objectives at too great an

expense to their adversaries. Site-specific circumstances and variations among communities, responsible parties, and government officials determine who ''wins' and who ''loses. ' With the Superfund syndrome, the system tears itself apart as it overresponds or underresponds at sites. Only rarely do cleanup **decisions satisfy all parties and meet the full range of statutory preferences and requirements.**

First, consider the root causes of the opposing views on cleanup risks and costs. One one side, there are people who are primarily concerned about risks to health and environment: the general public who knows Superfund indirectly through news media coverage and people in affected communities who have had direct experience with Superfund implementation. Repeated sharp visual images of leaking drums of toxic waste, pools of foul liquid waste, discolored streams and creeks, and abandoned homes near Superfund sites have etched permanent impressions in the minds of most Americans. Superfund's implementation has documented much chemical contamination of land and water nationwide. For years, the public has heard a steady stream of disturbing information about political scandals related to Superfund, criminal behavior of some toxic waste companies, continued conflicts between Congress and executive agencies over Superfund implementation, and slow, patch-work, and ineffective government actions documented in many reports by OTA, GAO, congressional committees, and environmental organizations. After a decade of such indirect experiences based on many sources of information, the American public has a lot of fear and anxiety about toxic waste sites.

At the community level, experience with the government's ineffective implementation of Superfund, as well as feelings about involuntary and catastrophic risk, cause outrage and distrust, dread, fear, and confusion. Again and again, people living near sites say they feel victimized; they face risks to health, environment, jobs, and home values; they feel left out of key decisions affecting their lives.[13] These experiences and emotions have increased people's perception of risks posed by toxic waste sites and made cleanup costs a secondary issue compared to obtaining effective protection of health and environment. [14]

Pressures from responsible parties push in the opposite direction. These pressures result, in part, from a perception that the toxic waste problem has been blown out of proportion and has caused an expensive over-reaction by government. In fact, the actual health effects of many chemicals are questionable or unknown, although many have known dangers. Natural processes of dispersion, dilution, and degradation can sometimes reduce health and environmental effects of released site contaminants, but this cannot be assumed. And chemical contamination of land and water does not *necessarily* translate to exposures to those chemicals and, hence, significant health or environmental risks or effects. For some people, therefore, perceived risk from toxic waste sites seems small compared to other environmental problems and too small to justify the large amounts of money being drained from specific companies and the general economy.

Many responsible parties believe that they have much more than money to contribute to

[13]EPA's routine community relations efforts are insufficient to prevent discontent in communities through early public participation and early dissemination of information. For sites managed under EPA's enforcement program, effective public participation is limited by the government 's interest in building a strong legal case.

[14]OTA has found it critically important to understand an important finding of risk communication: risk = hazard + outrage. (see peter M. Sandman, ''Hazard Versus Outrage in the Public Perception of Risk, '' in *Effective Risk Communication*, Vincent T. Covello et al. (eds.). (New York, NY: Plenum Press 1989), pp. 45-49. Hazard reflects scientific information about chemical contaminants, their health effects, and exposures to them. The outrage factor is a result of diverse experiences and feelings; for toxic waste it is higher than for other environmental problems, This explains why many Americans view toxic waste sites as more threatening than other environmental problems, even though more people are affected by other environmental problems (e.g., air pollution and radon contamination of homes), which pose high health risks.

Superfund's implementation, including technical expertise, project management experience, and more interest in trying innovative cleanup technologies than government. An expensive cleanup is not necessarily a truly effective cleanup, they argue and, as OTA's reviews of cleanup decisions have verified, that is often correct. As much as community people feel left out of the decisionmaking process, so do many responsible parties. Moreover, as much as community people may feel like victims because of threats from toxic waste, many responsible parties feel like victims because the liability imposed on them is not related to past violations of laws or regulations then in place.

Economics affects risk perception. For those being asked to pay cleanup costs, perceived risk is usually lower than it is seen to be in Superfund communities. (This lower perceived risk often changes when responsible parties become members of an affected community.) If risk is underestimated, then there is a potential for underresponses by the cleanup program. Moreover, this economic perturbation of risk sometimes occurs with EPA officials who, like responsible parties, place high value on minimizing individual cleanup costs in order to spread Federal money around to more sites. And they too may believe that risks are not as high as affected citizens believe them to be. Indeed, EPA has said this officially.[15]

Next, consider the causes and characteristics of excessive program flexibility. Normally, flexibility is valuable. Indeed, at the beginning of the program, flexibility was critically needed. Superfund was a new government program and cleaning up toxic waste sites was a new and largely unknown challenge. There was a true need for flexibility because there was little reliable information or experience to fine-tune policies and objectives. Today, after nearly a decade of experience and a lot of information, the flexibility in the program seems excessive, and seems to the public like a way to minimize costs by lowering protection.[16] There are too many opportunities for opposing interests—including the public—to achieve their objectives at too great an expense to others. **Government officials have too much room to make different kinds of decisions, and often contradictory ones at different sites, depending on circumstances and bureaucratic goals, such as obtaining settlements with responsible parties.**

Excessive flexibility means that there are few safeguards against underestimating risk and cleanup needs, and designing cleanups accordingly. This ultimately increases public concerns, which results in the public seeing more risk. Increased perception of risk leads to greater public demands, making it harder for government to satisfy expectations. But, excessive flexibility also allows over responses to heightened perceptions of risk. Selecting an overly stringent cleanup at a site or giving high priority to what seems like a less serious situation often prompts responsible parties and some government officials to fight the desired remedy or to reduce costs at other sites. And in some cases, there are several community groups expressing diametrically opposite views on cleanup objectives and remedies. This contributes to gridlock at the site level. If responsible parties refuse to go along with a stringent cleanup and EPA cannot compromise because of strong community positions, then the State may become the

[15] U.S. Environmental Protection Agency, *Unfinished Business: A Comparative Assessment of Environmental Problems*, February 1987.

[16] "Dubbed the 'maximum flexibility/yninimum accountability' approach by community groups living around the dump sites, this approach allows EPA to take into account numerous variables, most notably cost, in addition to the need to protect human health and the environment when cleaning up sites. . . [T]k major objection that environmental and community groups have about the current EPA approach is that it does not guarantee a minimum level of protection to citizens across the country; rather, a number of factors, many of which are never quantified or explicitly discussed, appear to determine the amount of contamination that will remain at the site after cleanup. " Linda E. Greer, "How Clean is Clean? An Environmentalist perspective," *Hazardous Waste Site Management: Water Quality Issues*, Report on a Colloquium Sponsored by the Water and Technology Board (Washington, DC: National Academy Press, 1988).

controlling factor because it may not provide the required 10 percent matching funds for what it considers an overly expensive fund-financed cleanup. The Superfund syndrome is sustained.

Excessive program flexibility entails:

- a great deal of EPA regional autonomy, permitting different interpretations of statute and EPA headquarters' policies (i.e., how much protection from toxic waste a person receives depends on where in the United States that person happens to live);
- a widespread belief among EPA staff that every cleanup is unique;
- a broad range of acceptable risk for setting cleanup objectives;
- no official definition for permanent cleanup;
- little distinction among the environmental results of very different cleanup technologies and methods;
- using cost-benefit instead of cost-effectiveness to justify selected remedies;
- using public opposition to an expensive treatment cleanup alternative to help reject it, but ignoring public opposition to a low-cost, land disposal alternative in order to select it;
- no specific criteria for using the statutory fund-balancing provision to reject high-cost cleanup alternatives; and
- selective use of different enforcement mechanisms.

Theoretically, responsible party concerns about cleanup cost might balance the demands for more stringent and effective cleanups by people at risk. But instead of opposing priorities creating optimum cleanups, the Superfund system often creates site decisions that individually overrespond or underrespond to site hazards. Site outcomes depend on the relative strengths of affected citizens and responsible parties at specific sites and often the views of the State. Without viable responsible parties, articulate community groups may obtain overly stringent cleanups. Without well-organized community groups, settlement cleanups may be weak. At those sites where there are both strong, united community and responsible party interests, gridlock is likely. [17]

In addition to the general public and affected communities, there are tens of thousands of people implementing Superfund, both government employees and contractors, who think that they have done the best they could with an impossible situation. Some people in Congress think that no matter what they do the program remains deeply troubled. Nearly everyone is frustrated, but nearly everyone has learned to find opportunities within the system excessive flexibility to achieve their goals, at least some of the time, or to prevent remedies they oppose, or to make implementation of them difficult. Cleanup decisions can be reopened or changed considerably during their implementation.

There is another complication. Spending billions of dollars has created a new industry. A legal, consulting, technology, and site and laboratory services industry thrives on Superfund and other cleanup programs. National cleanup spending is between $2 billion and $3 billion annually—and growing at a high rate, probably 20 to 40 percent for most companies in the business of cleanup. Changing Superfund inevitably affects the financial interests of this cleanup industry as a whole and, in a more complicated way, the relative competitive interests of different companies. Of ***course this*** industry is filled with people who genuinely care about the cleanup problem and about doing a good job. They too have to live with Superfund implementation problems, and they would like

[17] The effective organization of community interests into a single set of well-articulated demands and activities to achieve them seems to be determined by several factors. For example, the clearer and more imminent the threat to public health, the more likely it is that the community will rally around a particular set of cleanup objectives and remedies. Another factor is whether the community is able to tap the resources of a national environmental or public interest organization or local technical experts, such as engineering faculty. in some cases there may be a strong relationship with the prime responsible party which also is the community's chief source of employment.

to see them solved. But, overall, the cleanup industry pays little penalty for Superfund's ineffectiveness and inefficiency. Nor does it receive much incentive from the government for improved performance. Because of strong public support for Superfund, a backlash effect which would diminish cleanup activity has seemed unlikely. And the cleanup industry has benefited from other, growing cleanup programs. For the most part, this industry is viewed with distrust by communities because it works for the government and responsible parties which, as discussed above, are seen to have different priorities than communities.

Do Superfund Sites Pose Significant Health Risks?

Superfund was not created on the basis of lengthy, detailed studies which made the case for its need. Sup-fund was born out of something close to public hysteria, news stories about leaking toxic waste sites, vivid pictures of sites, and first-person accounts of health effects. **Do uncontrolled toxic waste sites in fact pose a problem that justifies a multibillion dollar program? The evidence available now indicates to OTA the answer is yes.**

First, mainly because of hundreds of Superfund studies (and the availability of advanced analytical techniques to detect smaller and smaller amounts of contaminants), there is massive documentation of substantial contamination of air, land, surface water, and groundwater in virtually every part of the United States. For many of the prevalent contaminants, there is undisputed information on adverse health and environmental effects.

Second, adverse health effects in populations exposed to releases of contaminants from cleanup sites have been documented (and some effects have not) through a few epidemiologic studies which, however, are almost always viewed by many professionals to have serious shortcomings. Examples of these are summarized in table 1-2; nearly all of them are controversial. Such studies are difficult and costly to conduct. Proving the contribution of *past exposures* to *currently* identifiable health effects, having many other possible causes, and in a mobile population is very difficult.

Third, Superfund has produced many exposure and risk assessments. These have documented past, current, and future exposures and risks through a variety of routes of exposure, including ingestion, inhalation, and dermal absorption, and for different types of people, including workers, residents, and occasional visitors. Risk assessment methodology has major limitations, often yields imprecise estimates, and produces numbers that very much depend on who does the work.[18] Using seemingly the same methodology, people working for the government or a responsible party can analyze a site and produce estimates of risk differing by a factor of 10 or 100, or even more. But the point is that many of Superfund's assessments have yielded undisputed high estimated current risks like 1 in 10 or 1 in 100 excess cancer deaths.[19] EPA's decision document for the cleanup of the Rose Township site in Michigan noted an excess cancer risk as high as 0.7 (i.e., 70 percent of exposed population dying of cancer) for consumption of groundwater contaminated principally with PCBs, vinyl chloride, and arsenic; and a non-carcinogenic risk as high as over 100 times the safe value, arising principally from

[18]The use of EPA's *Superfund Public Health Evaluation Manual* does not eliminate these problems. Also see Joel S. Hirschhorn et al., "Using Risk Concepts m Superfund," *Superfund* '87, proceedings of November 1987 conference, Hazardous Materials Research Institute, Silver Spring, MD.

[19]Other cleanups are justified only on the basis of estimated and, to a large degree, hypothethized future exposures and risks. Will residences be built on the land, groundwater be used as drinking water, or institutional controls such as fences and deed restrictions always be effective? *The uncertainly for future, potential risks is inevitably larger than for current risk.* But the statute requires cleanups for potential as well as current risks. And this requirement demands thinking through what *might* happen at a site. However, EPA has not routinely made an explicit distinction between future potential risks and significant *current* risks.

Table l-2--Summaries of Results of Some Epidemiologic Studies for **Toxic Waste Sites**

Hardeman County, Tennessee By 1977, 5 years after burial of pesticide production wastes had stopped, local residents were complaining of bad-tasting, smelly well water and were reporting health problems. Groundwater testing confirmed that a variety of chlorinated solvents had leached from the site, including carbon tetrachloride, chloroform, methylene chloride, and tetrachloroethylene. Providing a new water supply for some residents resulted in the disappearance of acute symptoms, such as nausea, diarrhea, skin and eye irritation, and upper respiratory infections But persisting problems were identified 2 years later, including enlarged livers and eye problems. Eleven county residents were hospitalized with a variety of symptoms. A limited health survey by the University of Cincinnati found evidence of liver dysfunction.

San Jose, California A water supply had been contaminated by leakage from an underground storage tank; 1,1,1-trichloroethane and 1,1-dichloroethylene were found in a municipal well. A study by the California Department of Health Services in 1980 and 1981 documented a doubled rate of spontaneous abortions in the exposed area as compared to a control area. The study also found a nearly four-fold increase in all birth defects combined. After the well was closed, a 1986 follow-up study found no excess malformations. In a different study, the rates of cardiac defects in the affected area were compared against the rest of the county. An excess number of major cardiac defects occurred in babies born to residents in the affected area for 1981. In May 1988 the State sad, that the leak, was an "unlikely" cause of the observed health problems, but also that "it probably will never be possible to determine conclusively what the role the leak played ."

Love Canal, New York In the 1970s there was ample evidence to residents of leaking toxic waste from the former disposal site. Testing confirmed heavy contamination in air, water, and soil, Beginning in 1976, local residents began reporting elevated incidence of a variety of health symptoms, Residents reported elevated incidences of miscarriages and children with multiple birth defects, severe asthma, and congenital heart defects, A 1978 preliminary health survey of over 100 residents by the Love Canal Home Owner's Association showed an increase in health problems; these included urinary tract problems, central nervous system disorders, and adverse reproductive outcomes such as miscarriages, stillbirths, and birth defects In August 1978 the State declared a health emergency.

Woburn, Massachusetts Drinking water was found to be contaminated with solvents at concentrations one-tenth of those in San Jose, California. Some residents were supplied with contaminated water to a much greater degree than others. In 1984, a team from Harvard University conducted a study The study groups were women who received less than 20 percent or more than 20 percent of their drinking water from contaminated wells. Relative risks were found to be elevated for eye and ear birth defects and for birth defects generally considered associated with environmental exposures, such as spina bifida, central nervous system problems, and cleft palate During the 3 years after use of the contaminated wells was discontinued, the relative risks of perinatal death and birth defects among exposed mothers were comparable to those in other parts of the community, Also, the incidence of childhood leukemia was Increased In Woburn, especially in the areas receiving almost all water from the contaminated wells. Childhood leukemia continues to be studied In exposed adults in Woburn, neurological damage, immunologic problems, and cardiac arrhythmias persisted for at least 5 years

SOURCE. Contractor work for OTA by ENVIRON Corp 1989

chlorobenzene in the groundwater. But these risks were for a ''hypothetical exposure' not a current exposure to the contaminated groundwater.

Table 1-3 gives a summary of descriptions of significant estimated risks at seven Superfund sites, based on EPA site documents. These examples illustrate the kind of results being obtained at Superfund sites, including sites for which cleanup has been justified only or partly on the basis of future potential risks. However, many times, actions are taken on the basis of information obtained about current releases of contaminants, likely exposures to them, and possible health effects. For example, New Jersey recently decided that it had to recontrol 86 sites contaminated with chromium by covering them with asphalt for perhaps 2 years until a final remedy is selected. Monitoring had found high levels of chromium in dust in a school.[20] Controlling windblown chromium dust to minimize health risks was the stated goal.

Other Reasons for Cleaning Up Sites

As important as health risks are, there are other reasons for cleaning up sites. Protecting the environment is important in itself. Also, damage to sensitive parts of the environment can signal future damage to human health for two reasons. First, toxic chemicals may enter our food chain, but take long times to manifest themselves as a cause of human health problems. Second, environmental damage may happen at low concentration levels, but contami-

The New York Times, July 26, 1989.

Table I-3-Examples of Use of Risk **Assessment to Justify Superfund** Cleanups

Baird and McGuire site, Massachusetts Future risk. Out of 102 contaminants, 53 critical contaminants were selected using methods suggested by EPA; they included 26 carcinogens, 11 noncarcinogens, and many suspected carcinogens. Because the site is not homogeneous in its geology, hydrology, and contamination, it was divided into 10 zones. The risk assessment focused on potential risks under hypothetical future conditions, because groundwater was not being used, a fence prevents direct contact with soil and surface water, there was no current fishing or recreational uses of the area. All the zones were found to have at least one pathway for exposure with the estimated incremental lifetime cancer risk greater than 1 in 10,000 and several pathways pose risks greater than 1 in 100. Moreover, all but two of the zones have at least one pathway with the Hazard Index for noncarcinogenic substances greater than the cutoff of one. The pathway showing the greatest potential risks was groundwater ingestion by adults.

Price Landfill **site, New** Jersey Future risk. Major groundwater contamination exists. The primary route of exposure was found to be ingestion of contaminated groundwater. Past and current exposures were evaluated for municipal and private water supply users. Actual concentrations of volatile organic chemicals in the groundwater supply wells were used. Although past risks were high for the municipal water users, current risks were low, even if it was assumed that the wells had not been taken out of production, which they had been. Risks for the private well users had in some cases been as high as 4 in 10,000 cancer risk, but the homes had been connected to public wells. A major groundwater cleanup was selected for the site, presumably because of potential future use of the groundwater. A qualitative risk assessment showed that ingestion of soil inorganic contaminants by children posed a significant risk which justified site capping and fencing.

Tinkam's Garage, Now Hampshire Future risk. Indicator contaminants were chosen based on concentrations of volatile organic chemicals found in groundwater, surface water, and soil, and their toxicity; there were 10 carcinogens and 10 noncarcinogens. Future risks were estimated on the assumption that an alternative water supply had not been installed, and residents continued to consume contaminated groundwater under two scenarios: either at the levels measured in supply wells, or at the maximum concentrations measured in site monitoring wells. The latter produced estimated cumulative cancer risk of 2 in 100 compared to 3 in 10,000 for the lower concentrations at the well point. For the noncarcinogens, the Hazard Index was over 30 for the higher site concentrations and 2 for the well concentrations. Two scenarios for children with oral and dermal routes of exposure to contaminated soil were used: a worst-case scenario assumed contaminant concentrations equal to the maximum measured values; a more-likely scenario assumed contaminant concentrations equal to the average measured values. The worst-case produced a cumulative cancer risk of 1 in 1,000 and the more-likely scenario 5 in 100,000. For noncarcinogens the Hazard Index was 1.7 for the worst-case and less than the cutoff of one for the more-likely case.

Summit Nationai **site, Ohio** Current and future risks. Studies showed the presence of more than 100 chemicals in different media on and offsite. Indicator chemicals were selected for groundwater, soil, and sediment, Under current use of the site and surrounding area, these exposure pathways were of concern: ingestion of site soils by trespassers, ingestion of offsite soils by residents and workers, and ingestion of sediments, Ingestion of groundwater under the current use scenario was not considered because onsite wells were not being used and local residential wells had not been found to be contaminated. For current use, the worst case cancer risks were in the 1 in 10,000 to 1 in 1 million range but the average exposures did not warrant cleanup using a cutoff of 1 in 1 million; nearly all of the Hazard Indices were below 1. The potential future use scenario considered ingestion of groundwater and soils by onsite workers and residents. An average (based on geometric mean contaminant concentration) and worst case (based on maximum detected value of contaminant) exposure were calculated. For future use, both the average and worst case scenarios could justify cleanup, with the worst case risks being as high as the 1 in 10 and 1 in 100 levels for the groundwater ingestion route; the Hazard Indices were very high for the worst case groundwater route, as much as 400.

Leetown Pesticide site, West Virginia Current and future risks. Risks were determined for exposure to most of the pesticides detected and arsenic. Ail major site contaminants were considered carcinogens. The current exposure route was ingestion of milk by local residents from cows fed silage grown in areas of soil contamination, assuming either all milk drunk was contaminated or that the daily mixed contaminated milk with noncontaminated milk. Only under the all-contaminated milk scenario was the risk significant enough to justify cleanup; it was at the 1 in 10,000 level. The future exposures were inhalation of contaminated dust and dermal exposure to contaminated soil by farmers tilling fields; this scenario assumed that the former orchards, then used mostly for pasture, might change to more intensive agriculture. Site sampling did not indicate groundwater contamination. Cumulative cancer risks for different areas were based on average contaminant concentration. For nearly all areas and for both inhalation and dermal exposure, the risks were high enough to justify cleanup, with inhalation risks being much higher and ranging from the 1 in 100 to 1 in 1,000 levels in four areas out of six.

Wildcat Landfill site, Delaware Current and future risks. Of 80 contaminants of heavy metals, PCBs, and other organic chemicals, 60 were used in the risk assessment. Current exposure pathways examined were: ingestion of groundwater by off site residents, incidental ingestion of surface waster from nearby river by occasional site users, ingestion of contaminated fish from river by occasional users, and direct contact with soil and surface leachate by occasional users. High excess lifetime cancer risk was estimated for current site users through inadvertent ingestion of contaminated soil (1 in 1,000) and through surface water (8 in 100,000). The cancer risk for current offsite groundwater users was 1 in 1 million. Future use exposure scenarios examined were: ingestion of groundwater by future onsite and offsite residents, and direct contact of soil and leachate by future site residents. The future potential risk for onsite residents consuming contaminated groundwater produced the highest lifetime cancer risk (4 in 1,000) and noncarcinogenic hazard index (104).

Sol Lynn/Industrial Transformer site, Texas Current risk. Site investigations found PCB and TCE in soil, plus several other organic contaminants. Risks were estimated for soil under current use scenarios. Only the risk of exposure to PCB through ingestion and dermal absorption was estimated. Due to the proximity of people within one mile (the Houston area) of the contaminated soil, exposure concentrations for PCB were assumed to equal maximum concentrations. The exposed population included workers, trespassers, and clientele of the businesses which currently operate at the site. Excess lifetime cancer risk associated with exposure to PCBs at the site was estimated to be 1 in 1,000.

SOURCE: Contractor work for OTA by Environ Corp., 1989.

nants may later be concentrated to high enough levels in food chains to affect human health.

Another reason for cleaning up chemical contamination of land and water is ethical. Many Americans believe that they, as individuals and as a society, have a moral obligation as guardian, steward, or conservator of the planet to keep our environment inhabitable-and to pass on to future generations an environment which is in as good or better shape than when we inherited it. They believe that cleaning up sites is important even without quantified certainty about health or environmental risk, or even if the costs of cleanup seem high relative to the benefits. American society does many things in the name of this environmental ethic, some of them expensive, which are not justified strictly on the basis of specific health benefits. Public concern about littering is a manifestation of the ethic. Superfund cleans up chemical littering which is as visible in people's minds as street or highway litter is to their eyes.

It seems that the moral or social reason for cleanup has a lot to do with the public's desire for permanent cleanups and for waste reduction at its source. Even after early cleanup actions have removed immediate health or environmental risks, going back to a site is important, in this view. For instance, addressing residual soil contamination or buried toxic waste (which may seem relatively immobile) fulfills the responsibility to leave the earth to future generations without our chemical litter. This moral value stands in contrast to a more materialistic perspective. Government officials are inclined to justify spending money on cleanups only when risk assessment and cost-benefit analysis support it.[21] Ethical considerations do not lend themselves to quantification.

Is Superfund Worth the Costs?

Inevitably, some people will focus on risk and cost information for cleanups to decide whether the costs and benefits of Superfund seem reasonable compared to other environmental programs, or even to very different government programs. In 1987, EPA's Administrator had a study done on risks from different environmental problems that concluded Superfund was an area of high agency priority and spending but low to medium health and environmental risks.[22] But EPA's conclusion about risks was not supported by analysis.[23] Another Cornparative examination concluded that ''reduced lifetime cancer incidence is often very small for Superfund cleanups and, compared to a problem like radon contamination of homes, the Superfund program seems clearly misdirected.[24]

In fact, cleaning up uncontrolled hazardous waste sites is expensive and will remain so. For Superfund, OTA estimates that the average cost per life saved, the commonly used program evaluation criterion, varies greatly from site to site, but at a rough average is $5 million, if only

---

[21] High marginal costs to achieve permanency and stringency are supported---demanded-by the public, because public cleanup demand = utility (protection) + morality. [See Amitai Etzioni, *The Moral Dimension* The Free Press, 1988.] But Superfund managers focus on utility, leaving some public expectations stemming from moral considerations unsatisfied. This contributes to the Superfund syndrome.

[22] U.S. Environmental Protection Agency, *Unfinished Business.' A Comparative Assessment of Environmental Problems*, February 1987. EPA 's view that ''total health impacts do not appear to match public concerns in most areas' sets up an adversarial relationship between communities and EPA on the key issue of different perceptions of risk and cleanup needs.

[23] OTA's examination of this study found several issues, including: the methodology was based on ''informed judgments'' and ''ex~~ opinion, ' rather than objective and quantitative analysis, from about 75 EPA managers and experts, only 2 of which were directly involved in Superfund implementation; there was no systematic compilation, presentation, and analysis of data from Superfund risk assessments or health effects studies; and the report acknowledged considerable uncertainty' for cancer risks because it considered only 6 chemicals and extrapolated information on 35 sites to a universe of *25,000* sites.

[24] Paul R. Portney, "Reforming Environmental Regulation: Three Modest Proposals, ' Issues *in Science and Technology*, Winter 1988.

cancer risks are considered.[25] Superfund costs are not absurdly high. To the contrary, they are comparable to those of other government programs, especially if about half of the spending is allocated to health, environmental, and social benefits other than preventing cancer deaths. These can be significant for many sites.[26] The larger issue is that unless Superfund's performance is improved, cleanup costs may increase and benefits may decrease, making the program seem economically irrational relative to other national needs.

Strategy v. Spending

Few people question cleaning up chemically contaminated land and water, both for our own sake and for the sake of future generations. The tough question is: How much cleanup is really necessary? Insisting on perfect, quick and certain solutions, and ignoring resource limits can defeat cleanups of specific sites and threaten the national program. Conversely, insisting on low-cost cleanups can compromise protection of health and environment. The unsuccessful attempt to balance Superfund's environmental goals against technical and economic resources has revealed the lack of a well-crafted, long-term strategy in statute or implementation.

Much of the past policy debate focused on Superfund funding levels and who pays, and not about strategy and priorities. Ideally, Superfund would eliminate all significant risks at all uncontrolled sites through permanent cleanups. In reality, however, limited financial, human, and technical resources make this ideal unattainable in the short term. The question, therefore, arises: what is the most efficient means of allocating Superfund's limited resources to achieve maximum protection of the public and environment? The answer to this question lies in how the spending is to be distributed with respect to sites and time. In other words, strategy, not just spending, has to be considered.[27]

Currently, spending is focused on relatively few sites and on complete, defensible cleanups at those sites, which are often, nonetheless, hotly debated. Many sites—both known and as yet undiscovered—remain largely unattended. **In trying to deal with resource constraints, a host of largely ad hoc policies minimize: 1) the number of sites entering the program; 2) the number of sites deemed to require cleanups under Superfund; 3) sometimes the level of site cleanup; 4) often the cost of site cleanup through remedy selection; and 5) expenditures from the fund through settle-**

[25] In comparison, the study mentioned in footnote 22 calculated a cost of only $2,500 per lifetime case of lung cancer prevented by radon remediation. The OTA estimate of $5 million per fatal cancer prevented from Superfund sites is based on the figures: 2,000 sites with a total of 10 million people at risk, a cancer risk reduction from 1 in 1,000 to 1 in 1,000,000, and an average cleanup cost of $25 million. The average exposed population of 5,000 people per site is consistent with EPA figures. (EPA, "Extent of the Hazardous Release problem and Future Funding Needs--< ERCLA Section 301(a)(l)(C) Study, December 1984. Mean populations exposed were 5,000 for groundwater and 3,600 for surface water; since HRS scores have not changed significantly, these figures still seem applicable.) However, because of uncertainties about risks and cleanup costs as well as large variations in site risks and cleanup costs, the cost per cancer death prevented probably varies plus or minus a factor of 10, from about $500,000 to $50 million per cancer death prevented. Sites at the high end result from complex contamination, requiring expensive cleanup, but posing low health risks or affecting relatively few people, or both; however, *other* benefits for such sites may be significant.

[26] Work for the Department of Energy's cleanup of hazardous waste sites uses a value of $5 million as Consistent with preventing a fatality. (Miley W. Merkhofer et al., "A Program Optimization System for Aiding Decisions to Fund the Cleanup of Hazardous Waste Sites at Department of Energy Defense Facilities, " *Superfund '88*, proceedings of November 1988 conference, Hazardous Materials Research institute, Silver Spring, MD.,) Other benefits include preventing or minimizing non-cancer health problems, loss of home values, and loss of a community's economic activity and development. Moreover, addressing environmental problems could be significant; for example, in 1984 EPA estimated that about half of NPL sites posed threats to sensitive environments such as freshwater wetlands, coastal wetlands, and critical habitats. Current EPA guidance suggests that a regulation is warranted if the cost per life saved is less than $1.5 million. Most Federal agencies regulate vigorously if the cost per life saved is about $2 million *or less.*

[27] Supporting this perspective is the following comment by Tom Grumbly, President of Clean Sites Inc.: " 'The EPA has a history of lurching from one tactic to another without having developed an overall strategy. . Although 1'm sympathetic to the view that some of the Superfund commentary has been negative, criticism can be traced back to EPA's failure to articulate a definite strategy. " *Environmental Business Journal*, May 1989.

ments with responsible parties. Such actions erode public confidence in Superfund, making managing it even more difficult,

Two facts about the Superfund program are worth recalling. First, even after nearly a decade, Superfund is still in its experimental stages. It is an evolving program which *has* provided some benefits. For example, enormous amounts of toxic waste and contaminated soil and water have been identified and many sites which posed significant immediate threats to health and environment have been addressed through emergency and removal actions. But the **Nation has probably spent only about 1 or** *2* **percent of what ultimately might be spent by all parties** to clean up chemically contaminated sites—now roughly estimated by **OTA at $500 billion over 50 years.**

Second, although the program seems largely ineffective and inefficient in meeting its objectives, most attention has focused on specific events, sites, decisions, and narrow policies. This has blocked seeing the *whole,* complicated Superfund program and examining broad policy and implementation issues. After the original statute was passed in 1980, the accumulation of many administrative and legislative decisions (in the 1986 Superfund Amendments and Reauthorization Act—SARA) have shaped and reshaped Superfund. Congress, EPA, and the public have not had the benefit of a major policy discussion of where Superfund has come from, where it is today, and where it might go during the next 10 years and during the decades thereafter.

Different Perspectives on Fixing Superfund

Among those who see a need for change, there are fundamentally different perspectives on how to fix Superfund. Can incremental fine-tuning work or are fundamental changes necessary? In this report, *both* types of improvements are identified and discussed. **Incremental changes (called program changes in this report) tend to be easier to implement in the near term and are useful, but OTA's assessment is that fundamental changes (called strategic initiatives in this report) will be necessary for an effective long-term program.**

Many people see Superfund mostly in terms of its financial and legal dimensions and believe that how Superfund is financed, how much money it gets, how it is enforced, and how it imposes liabilities are key. For these people, some changes in these areas seem justified. But it is Superfund's environmental mission which is its reason for being, and environmental and community groups work hard to keep attention focused on that mission. All other issues pale in comparison. **Stressing non-environmental goals (e.g., numbers of cleanup decisions and actions, dollars obtained from responsible parties) polarizes environmental and community interests against those of industry and government, and it encourages EPA officials to lose sight of their mission.**

Moreover, there are clear links between certain groups and non-environmental issues; for example, major parts of American industry, which face paying for cleanups, and Superfund contractors would like changes in Superfund's liability provisions; by virtue of their training and interests, many people in the legal world and government are inclined to see enforcement as the key issue; industrial and insurance groups focus on level of funding and how the money is raised through taxes and fees. It is important to see whether, and if so how, addressing non-environmental issues affects the environmental performance of the Superfund program.

POLICY OPTIONS TO IMPROVE SUPERFUND

Summary Policy Overview in Three Key Areas

Health and Environmental Priorities and Goals

Expensive cleanup actions could be postponed when: 1) risks are not current, or 2) selected remedies are not to likely produce a

Box l-C—Three Kinds of Inefficient Superfund Spending[1]

(OTA estimates that between 50 and **70** percent of current Superfund program spending is inefficient and undermines the environmental mission of the program. We discuss below three kinds of inefficient spending and explain how we arrive at the estimate of 50 to 70 percent. At any one site, some or all types of inefficient spending may occur. Many of OTA's policy options are meant to address one or more of the three areas.

L Spending to address uncertain future exposures to hazardous substances released into the environment or remaining onsite and, therefore, speculative future risks to health and environment. OTA's examination of FY87 and FY88 RODS and **a study by Oak Ridge National Laboratory** of FY87 RODs[2] found that, overall, EPA finds about 50 percent of cleanups necessary primarily or, in many cases, solely because of hypothetical, speculative, and uncertain future exposures and risks. (See table 1-3 and discussion of policy option 1.) OTA analysis of data in the **ORNL report** substantiates that the percent of cleanup costs attributable to uncertain future risks is about the same as the percent of cleanup decisions. Therefore, about 50 percent of cleanup costs (whether paid by government or industry) are likely directed to reducing hypothetical risks which may not materialize. OTA calls such spending inefficient because of the opportunity costs, including: inadequate spending on site discovery and early site assessment, inspection, and ranking (i.e., EPA's preremedial activities); delayed cleanup of sites which pose current exposures and risks, and whose cleanup costs may escalate as contamination spreads into soil or groundwater; and the deferral of cleanups from Superfund to other, often less effective cleanup programs (e.g., States), motivated in part by the need to save Superfund money.

2. Spending on cleanup remedies which are unlikely to be permanent, leading to more spending in the long term for re-cleanups and perhaps posing expodures, risks, and damage to health and environment. OTA considers that a site has been permanently cleaned up when the contamination that was the cause of high enough risk to warrant cleanup (either current or future risk) is rendered irreversibly harmless through destruction (e.g., incineration or biological treatment) or recovery and muse of the hazardous substances (e.g., recovery of lead from contaminated soil and buried battery casings). Using this definition of a permanent cleanup, about 75 percent of FY87 and FY88 RODS selected impermanent remedies for cleanup of onsite hazardous waste and contaminated soil (see ch. **3). (An even higher percent of removal actions use impermanent remedies.) Also,** about 75 percent of groundwater cleanups use technology that experience is now showing to be unreliable in practice, even though it seemed to be permanent in theory. (See ch. 3's discussion of pump and treat for groundwater cleanup.) For these cases, the relationship between percent of decisions and percent of spending has not been assessed quantitatively. But on the basis of its examination of FY87 and FY88 RODS, OTA concludes that impermanent remedies contribute **substantially to inefficient spending on cleanups,** even though impermanent remedies usually cost less than permanent ones (see OTA's 1988 case study report and ch. 3). For example, if impermanent remedies on average cost one-third as much as permanent ones, and three-quarters of decisions are for impermanent remedies, then half of total spending is for impermanent remedies, and is inefficient. OTA calls such spending inefficient, because impermanent remedies provide uncertain long-tan pmection of health and environment and may lead to substantial future re-cleanup costs.

Now assume, in line with Point #l, above, that spending on impermanent remedies is distributed 50/50 between cleanups justified primarily or solely by future risks and those with current risks. Then, avoiding double counting of inefficient spending, 75 percent of spending is for impermanent remedies and future risks. And looking at the extremes, we see that, atone extreme, if all impermanent remedies are for future risk sites, then the total of inefficient spending is still 50 percent; at the other extreme, if all impermanent remedies are for current risk sites, then the total of inefficient spending is 100 percent. OTA concludes that probably 75 percent of the money spent on cleanups is inefficient because of the reasons discussed in Points #1 and #2. Forty percent (or $1.7 billion) out of EPA's Superfund total spending (of $4.4 billion) from FY86 through FY89 is for cleanup[3] and therefore, 30 percent of total program spending is probably inefficient because of the two reasons we have just discussed. **We discuss the other 60 percent of program spending in Point** #3, below.

3. Spending on the administration and management of the program, extensive site studies, and prolonged negotiations and litigation between government and industry (responsible parties) which is either unnecessarily **high or avoidable with different policies and program management.** From FY86 through FY89, about 16 percent (or $7(K) million) of EPA's Superfund total spending (of S4.4 billion) was for site studies and 44 percent (or $1.9 billion) was for all types of administration and management activities.

Examples of unnecessarily high or avoidable study costs are: 1) RIFSs which have been of such low quality that further studies by responsible parties, or work in the design phase or even work during actual cleanup has revealed the need to redo the EPA work; 2) RIFSs that have not made effective use of information from preremedial site studies, from removal actions, or earlier studies by responsible parties; 3) redundant, concurrent RIFSs by EPA and responsible parties motivated by distrust of the accuracy or completeness of the other's work; 4) RIFSs for site problems that could have been judged on the basis of prior information to pose only future risks and, therefore, which could have been deferred; and 5) many policies and program requirements which lead to excessive or ineffective analysis of cleanup alternatives. (See OTA's policy options on, for example,

defining and limiting permanent cleanup, hierarchy of cleanup methods, using site generic classification, and using technical assistance experts in generic types of sites and technologies.)

Two examples of unnecessarily high or avoidable administrative and management costs are particularly important. The first concerns the large and complex system of contracts by which EPA spends about 90 percent of its funds. As we discussed in our background paper,[4] this contracting system has not been structured to achieve efficient spending nor has it been managed efficiently.[5] Secondly, the high level of autonomy given to EPA Regions, coupled with ineffective central management oversight and control by EPA headquarters mean that cleanup decisions are often vulnerable to challenge because they are inconsistent with EPA policies or statutory requirements.

In OTA's judgment, a major cause of unnecessarily high or avoidable costs for prolonged negotiations and litigation is the excessive flexibility inherent in the current program (see discussion at beginning of this chapter). As a consequence of excessive flexibility, there are many points of conflict or disagreement about cleanup objectives, about remedy selection, about enforcement of liability. These disagreements become the basis for prolonged and expensive negotiations and litigation between the government and responsible parties (and often among responsible parties). In turn, confrontational negotiations and litigation lead to excessive and overly defensive studies and analyses to bolster the positions of adversaries.

OTA sees no possibility for precise quantitative analysis of the linkage between these areas and spending. However, it is OTA's judgment that a substantial fraction of current spending on studies, administration, management, negotiation, and litigation is inefficient, Support for this view exists. EPA has recently said that it wants to reduce RIFS costs by about 32 percent, and a number of EPA Inspector General and GAO reports have documented wasteful spending in the Superfund program. Moreover, the Army Corps of Engineers, which carries out large, complex engineering projects, spends only about 10 percent of its total budget (which is about twice that of Superfund) on administration and management compared to Superfund's 44 Percent.[6] If we assume a range of one-third to perhaps two-thirds for inefficient spending, and apply it to the 60 percent of total program spending covering these efforts, then from 20 to 40 percent of total program spending is inefficient because of the reasons discussed here in Point #3. OTA defines as inefficient those administrative, management, study, and transaction costs that do not contribute to timely and effective cleanups. Unnecessary and avoidable spending outside of actual cleanups preempts spending time and money on identifying and solving significant current health and environmental problems.

Conclusion---Combining the 30 percent from Points #1 and #2 with the range of 20 to 40 percent for Point #3, we estimate that 50 to 70 percent of spending in the Superfund program is inefficient. This range probably also applies to private sector spending on Superfund activities. Responsible parties perform about half of current site studies and cleanups and many of their activities and problems mirror EPA's. For example, they also bear high administrative, management, and transaction costs. But the mix of private sector spending in the latter area is probably different than for EPA. Responsible parties are probably spending much more, proportionately, on litigation than on studies, administration, and management. In addition to negotiation and litigation with the government, responsible parties are in negotiation and litigation with other responsible parties, insurance companies, and private citizens and community groups. One recent review of Superfund concluded that 'of the total funds spent since 1980 . . . something between 30 and 60 percent has gone for legal expenses."[7] Of course, not all legal expenses are unnecessarily high or avoidable, but, here too, OTA believes it is fair to estimate that a significant portion of legal spending is unnecessarily high or avoidable and, therefore, inefficient.

---

[1]Not all inefficient spending is a *complete* waste, much of it produces something of value butt& spending is either suboptimal relative to program priorities (or what t& public thinks they should be) or it preempts mom productive spending.

[2]Carolyn B. Doty and Curtis C. Travis, *The Superfund Remedial Action Decision Process*—draft, undated, contract work performed for EPA. Fifty out of seventy-four RODs were examined.

[3]Based on OTA's analysis of EPA budget documents.

[4]U.S. Congress, Office of Technology Assesment, Assessing *Contractor Use in Superfund—Background Paper*, OTA-BP-ITE-51 (Washington, DC: Us. Government Printing Office, January 1989).

[5]Nor has contract procurement and contractor performance oversight been sufficient to identify and prevent fraud, waste, and • buse. Sea EPA's Inspector General reports on Superfund in March and September 1988, and a number of GAO reports on Superfund contracts.

[6]The comparison between Superfund and the Corps is approximate; for example, the Corps does not have expenses for cost recovery, but it faces costs for siting facilities, and these may offset each other.

[7]Maurice R. Greenberg, "To Clean Up the Residue of Progress, A National Environmen tal Trust Fund," *Financier*, April 1989. The observation seems *to have* been made for both government and private sector spending.

permanent remedy. Box 1-C presents a discussion of the kinds of inefficient spending, one of which is spending to address future risks and another on impermanent remedies. That spending could be used to bring more critical sites into and through the Superfund system, receiving

fast interim attention and major—but not necessarily complete—risk reduction. Only when expensive thorough cleanups are necessary to address current risks would they be used, unless responsible parties wanted to finance cleanups for future risks. The cost for faster and more widely distributed near-term protection on the most hazardous sites is that many less hazardous sites would be waiting for their final cleanup. Essentially, with this strategy, the current backlog at the front-end and in the middle phases of Superfund would be exchanged for a backlog at the back-end of the program.

There are other components to the overall strategy. Another kind of inefficient spending is for umecessarily high or avoidable administrative, transaction, and study costs. This is the third factor discussed in box l-C.

Workers and Technology:

1. Improve quality of government and contractor work to reduce costs of making and fixing mistakes in studies and actions.
2. Develop and use technologies and methods which reduce unit costs for site investigation and cleanup and provide better information for decisionmaking.

Government Management:

1. Through improved technical capabilities, make the system more efficient by reducing time and cost for necessary tasks, particularly site studies for a larger number of sites moved into the system, and by eliminating unnecessary tasks.
2. Reduce unnecessary and unproductive transaction costs and delays related to enforcement, lack of public confidence, and policy conflicts.
3. Provide clearer program needs, goals, and priorities to the private sector, and promote competition among private sector providers of services.

Policy options

There are many near- and long-term ways to improve the environmental effectiveness and economic efficiency of Superfund. The 38 policy options described below are comprehensive but not exhaustive. They are diverse—some are broad, substantial changes in the direction of the program and have been called *strategic initiatives.* Implementation of a significant number of the strategic initiatives would result in a restructuring of the program. By their nature, the strategic initiatives will engender strong support or opposition from different interest groups. Other policy options are called program *changes,* and these could be integrated into the current program. Each option has the potential to improve Superfund. They are *not* mutually exclusive or mutually dependent; each option stands on its own. All or some of the options could be implemented although, as discussed below, some of them are strongly related to others.

Although some of the following policy options might be implemented solely by EPA, the focus is on congressional actions. And even when an option might, theoretically, be implemented by EPA alone, considering the history of Superfund, it may be beneficial for Congress to express itself. When OTA's assessment had been nearly completed, EPA released its report *A Management Review of the Super-fund Program* (June 1989); it was the result of a limited 90-day EPA review of the Superfund program. OTA has not presented a detailed comparison between EPA's intended actions and OTA's findings and policy options. A follow-up EPA report will provide the necessary details on how EPA's recommendations will be implemented.[28]

EPA's report announced "a new long-term strategy for Superfund" and presented 50 recommendations for improving Superfund. In general, there is some agreement between EPA's

[28]The House Committee on Appropriations said "While the report of the 90-day *management* review contains many thoughtful recommendations, it remains to be seen what decisions will be made and what actions will be taken to make these reforms a reality. Report 101-150, July 17, 1989.

and OTA's identification of major problems and issues. **The EPA report offers an important recognition of problems in the Superfund program, and its specific recommendations for improving the program are significant within the effort's attempt to fine-tune the program and not make major changes in it.** Many of the specific issues addressed by OTA and its policy options, however, are not similar to those in EPAs report, including, for example: site discovery, preremedial site evaluation, selection of remedy, permanent cleanup, cost-effectiveness, variable cleanup objectives, impact of settlements on cleanup decisions, and inconsistencies with statutory preferences and requirements.

Below, the basis and nature of each OTA option is discussed, then its benefits, and then implementation issues, including concerns, problems, and costs. Linkages to other options and chapters in the report are also made. Before reading all 38 policy option sections, the reader will probably find it useful to peruse table 1-1 to get some sense of their scope and diversity.

PART I: Strategic Initiatives

Setting Cleanup Priorities and Goals

OPTION 1: Set Priorities on Basis of Current or Future Risks

There is a desperate need to find an environmentally sound way of setting priorities and making hard choices. Current implementation is too influenced by non-environmental factors, such as the willingness of a responsible party to pay for cleanup, or the ability of communities to get political and news media attention as well as support from national organizations—which depends more on a community's affluence or education, than on environmental needs. With this option, a critical distinction would be made between current and future health and environmental risks posed by sites on the NPL. That decision could be made in an official EPA decision document, including the supporting facts and analysis, or it might be included as part of a site's initial proposal for the NPL or as part of an initial ROD. Box 1 -D presents questions likely to be raised about this option and OTA's responses to them.

Cleanup actions based solely or primarily on future potential risks would no longer compete on an equal standing with actions justified on the basis of current risks or damage to sensitive environments. For example, Class I sites would pose current risks to health or environmental damage and Class II sites would pose future potential health risks or environmental damage. However, the delayed cleanups for Class II sites would not replace the priority assigned to interim recontrol actions necessary to prevent sites from becoming worse through the spread of contaminants into the environment. Moreover, assignment to either Class would not be rigid; new information about a site or actions at a site could justify reclassification.

Major decisions and allocation of resources within all Superfund implementation phases would automatically put Class II sites into a second, lower priority state; within Classes priorities might be based on chronological order of initial site discovery or identification (which would serve as a worthwhile incentive for early site discovery), and/or relative levels of assessed risks.[29] Classification could change over time, as actions (what EPA now calls removals and operable units) are taken at a site to mitigate risks. The default option when too little information exists for making a judgment about current v. future risk would be a Class I designation.

Exposure and risk assessment are by nature imprecise and produce uncertain results which are dependent on who does the work. Neverthe-

[29] One approach could be to establish high, medium, and low ranges of risks within Classes I and II. For example, for carcinogenic risks, High = greater than 1 in 1,000, Low = less than 1 in 1, 000,000, Medium = the range between High and Low; for use of the Hazard Index for non carcinogenic materials, High = greater than 50, Low = less than 2, and Medium = the range in between.

Box I-D-Questions and Answers About Policy Option 1

***Is This Idea Inconsistent* With Current Law And Program?**

The law requires a consideration of present and *potential threats to* health, welfare, and environment. From the very beginning of Superfund, it was recognized that some threats are imminent, even emergencies sometimes. Thus, the need for the removal part of the program. However, in the most expensive part of the program--remedial cleanups-an explicit distinction between current and future risks has not been made. If the scope of the national cleanup problem were small, it would not be important to make this distinction. But with so many sites requiring cleanup, not making this distinction means that some sites which pose risks in the near term may not get cleanups in the near term, while other sites which might pose some risk in the future will get cleanups in the near term.

Is This Idea Just a Way To Reduce Superfund Spending?

This option has no bearing necessarily on increasing or decreasing total Superfund spending. This option only provides away to decide priorities and to decide exactly how whatever money is appropriated or otherwise made available is spent.

How Do We Know Whether a Site Poses Current or Future Risks?

The key to moving beyond information about site contamination with hazardous substances to risks is to evaluate specific paths of exposures. Exposure pathways will be based on some current condition, such as people having contaminated groundwater as their only source of drinking water, or some possible future condition, such as people using a site for recreation or housing and children possibly eating contaminated soil. Cleanup may be wholly or mostly justified on the basis of current or future exposure, or some portion of a site may be assessed to pose current exposure and another only future exposure.

If Risk Assessment Has So Many Problem% How Can We Confidently Assess Current v. Future Risks?

Exposure assessment combines qualitative information about a site's contamination and human and ecological receptors which can contact the contamination. Formal, quantitative risk assessment, based on detailed dose-response relationships, has more uncertainty and is not necessary.

Will Addressing Current Risks First Mean Using More Low Cost Actions Like Land Disposal?

Placing the highest priority on addressing current risks may entail using recontrol and interim actions to reduce current risks to safe levels. Those actions may use permanent technology which is practical and cost-effective or they may use other kinds of treatment technology, land disposal or containment, and institutional controls. But no site would be considered finally and completely cleaned up--and delisted from the NPL-unless permanent cleanup technology had achieved a final cleanup.

Will Sites Ever Get Permanent, Final Cleanups?

Sites will get their current risks addressed, possibly with permanent cleanup technologies, but may have to wait for a final cleanup which addresses future risks. But eventually the government must provide such sites with final remedies which use permanent cleanup technologies to the maximum extent practical.

If Future Risks Are Not Worth Addressing Now, Why Spend a Lot of Money Later on Expensive Permanent Cleanups?

This option does not change the current law or national policy. The government is just as obligated to permanently clean up sites which pose potential risks as ones which pose current risks. The issue addressed by this option is the timing of final, permanent cleanups. The Nation has already decided that it is worth cleaning up sites to protect health, welfare, and environment. But since we cannot do everything at once, some environmentally sensible way of allocating scarce resources is necessary.

less, the uncertainty about future potential risks is intrinsically different qualitatively. Study of past Superfund site decisions shows that many cleanups are based on hypothesized scenarios, such as possible future use of land or groundwater (see box l-E). Indeed, EPA sometimes has

Box 1-E—Example of Using Current v. Future Risk in Cleanup Decisions

The approach in Policy Option 1, of using the distinction between current and future risk as a primary way to decide whether to clean up a site, is used currently, to some extent. The Record of Decision for the first operable unit of remedial cleanup for the Arkansas City Dump site in Arkansas City, Kansas was signed in September 1988.

A key part of the decision was that there was only one current risk which required near-term attention. That risk was direct exposure by onsite workers to acid sludge; workers might get burned if they came into contact with the 47,000 tons of the sludge onsite.

However, the groundwater under the site was found to be heavily contaminated with arsenic, beryllium, and a group of polynuclear aromatic hydrocarbons. The total carcinogenic risk resulting from long-term ingestion of the groundwater was said to be greater than 1 in 1,000 (actually, the figures in the ROD suggest a risk in the order of 1 in 100, which is very high). Testing of offsite groundwater did not find contamination from the site.

The ROD **said:** "It must be remembered, however, that the risk of cancer is present only if consumption of ground water from contaminated aquifers were to occur based on a 70-kilogram adult over a 70-year lifetime. At the present time there is no known consumption of onsite ground water, and consumption of offsite water poses no risk. ''

With this reasoning, EPA elected to postpone consideration of groundwater cleanup until **a second operable unit** ROD. However, from a discussion OTA staff had with the site's remedial project manager, it appears that EPA may not pursue groundwater cleanup. Indeed, on the basis of the absence of current risk and lack of evidence that contaminants are causing a problem in surrounding groundwater or the nearby Arkansas River, EPA could maintain the same reasoning used in the first operable unit ROD. The only complication is that EPA invoked the formal waiver provision of **SARA** in order to postpone groundwater cleanup in the first ROD. This was necessary because the groundwater contamination was found to exceed State and Federal drinking water standards. The issue for the future becomes whether EPA can postpone groundwater cleanup on the basis of no current **risk and,** if that is the case, also postpone addressing the source of the groundwater problem. The latter seems to be a large amount of subsurface petroleum material and buried metallic waste.

The estimated cost of the remedy selected in the frost ROD is less than $1 million; it is based on in situ neutralization of the acid sludge and a soil cover. If complete source **control** and groundwater cleanup were pursued, cleanup would probably cost from $20 million to $40 million.

With OTA's Policy Option 1, deferral of this groundwater cleanup and full source control would be acceptable, but the site would not be considered permanently cleaned up, it would not be delisted from the NPL, and there would be continued monitoring of the surrounding groundwater offsite as well as institutional controls prohibiting use of onsite groundwater. **As the above figures** show for this example, a relatively large amount of money would become available to address current risks at other sites. This example, however, also shows the difficulty of postponing expensive cleanup, for addressing future risks, under current statutory requirements.

SOURCE: Office of **Technology Assessment,** 1989.

applied this option, as illustrated in box l-E. This example shows the considerable potential for shifting spending with this option.

Benefits: It is sound environmental thinking to defer actions when risks are future, potential, and highly uncertain. The chief benefit would be channeling Superfund resources where they are most needed. At many sites, limited cleanup actions may effectively deal with current risks, while leaving future uncertain risks for future actions, as resources become available. This means that site studies would be smaller and faster, because whole final remedies require much more study. (Other options presented below would help reduce studies.) Interim remedial actions would be easier to define and implement.

The cost of not delaying final remedial cleanups is to postpone attending to sites with more certain current risks. Postponement means

that people suffer health effects, sensitive parts of our ecology are damaged, and sites get worse from the spread of contamination.

Another benefit is that criticism of many cleanups would be reduced; what often now appears to be an inconsistent or ineffective final remedy may be a compromise remedy because the site only poses a future, uncertain risk. Currently, instead of not acting (or using a recontrol approach), a lower cost, less stringent final cleanup is chosen, in part because responsible parties and government officials want to reach closure on sites.[30]

Finally, delaying final cleanup probably increase the chances that an innovative treatment technology leading to better cleanup will be available.

Implementation: The current statute requires EPA to address future potential risks; it does not, however, preclude EPA from implementing this option. However, because this option would have major impacts, congressional action seems necessary. This option could be implemented along with the currently used Hazard Ranking System. With current site study and risk assessment practices it is possible to identify the difference between current and future risks, and to distinguish current or potential environmental damage. For example, consistent with OTA's observations, the Oak Ridge National Laboratory study was able to distinguish between current and future risks in all but 4 of the 50 RODS it examined.

The State of Missouri uses a site classification system which makes the kind of distinction discussed here. The State notes that:

> The relative need for action at each site is based solely upon the potential impact of the site on public health and the environment. The type of action required, the feasibility of such an action, and its cost benefit are not the primary factors in deciding whether the action is needed.[31]

The Missouri experience demonstrates an important aspect of current-future risk classification: it does not require detailed, quantitative risk assessment. Qualitative analysis of a site and exposure routes can be sufficient to identify the presence of future risks for all or part of a site. New Jersey has recently found it necessary to distinguish between 'proximate risk and long term priorities'' in order to ''ensure work on the 'worst' cases first' and to ''allocate resources to high priorities. A proximate risk remedy or

30A good example of this is the FY88 ROD for the Coshocton City Landfill site in Ohio (discussed in ch. 3). The responsible parties contested EPA's proposed containment remedy successfully and a less stringent containment cleanup was obtained. The responsible parties said: ''Gwen the neglible present risk and speculative future risk, the remedy would not seem to meet any kind of test for cost-effectiveness. . . In the absence of any significant present threat to human health and the environment, EPA appears to rely on the potential threat of future releases and their postulated impact on human health and the environment as a justification for requiring corrective action at the site. EPA admitted that potential threat of future releases was a' 'major factor' in its original remedy selection. OTA's point is that, with this option, EPA could have defended a *need* for a *recontrol* action-perhaps as stringent as its original containment remedy—and eventually had a strong case for a stringent final remedial cleanup. With the current ROD, there is considerable uncertainty about how future cleanup needs will be addressed after the likely settlement is obtained, and public accountability is minimal after the ROD. Similarly, the remedy selected in the fiscal year 1987 ROD for the large Bayou Sorrel site in Louisiana, which gets flooded periodically, essentially gave the responsible parties the containment remedy that they wanted in order to agree to a settlement, but which had been opposed by most of the comm unity and others. In an internal memorandum urging approval of the remedy, EPA staff noted that ''the endangerment posed by the site is questionable and the risk assessment for the site is not well prepared. With this option, the containment action would be considered a recontrol, interim remedy requiring close monitoring, rather than the final cleanup with delisting from the NPL. It also has become clear, since the completion of the Feasibility Study in early 1986, that the cost of the rejected onsite incineration option has become much lower than the one estimated originally.

31 I Briefly, Missouri's Class I sites pose imminent danger and require immediate action; this is like EPA current emergency and, possibly, removal actions. Class II sites pose significant threat and require action; this is like EPA's current remedial cleanup program. But Class 111 sites are such that action may be deferred. Here are some examples of statements for specific Missouri sites which illustrate the nature of Class III sites, confirm the feasibility of identifying future risks, and show the consistency with the approach of this policy option: ' 'There are no known environmental problems at the present time, but there is the potential for surface and groundwater contamination at the site due to the leachable nature of the wastes. ''Following remedial actions at the site, residual contamination remains in the soil and groundwater. Groundwater in the area is not used for drinking. ''. . . the potential does exist for soil and surface water contamination if drums deteriorate. "''No environmental problem exists at this site unless it is disturbed by construction and/or drilling. " "There is some possibility for contamination of groundwater due to permeability of the soils. Surface water contamination from erosion is also a possibility. Missouri Department of Natural Resources, Division of Environmental Quality, "Confirmed ***Abandoned*** or Uncontrolled Hazardous Waste Disposal Sites in Missouri—Fiscal Year 1987 Annual Report. "

interim action addresses "areas of immediate environmental concern, in which it is possible and necessary to control the contaminant source and reduce or eliminate the threat to the potential receptors." [32]

An immediate question to raise is: What is current? A legitimate environmental concern is potential abuse of the current-future risk distinction by an over-zealous placement of sites into Class II. Functionally, the need is to define whether a cleanup action is necessary in the near term or whether it can wait for some years. The planning horizon for site cleanup is about 5 years, from serious site study to serious implementation of the selected remedy. Therefore, if an exposure currently exists or is likely within about 5 years, the risk could be considered current. If this period is increased (i.e., moving from what exposure is likely to what may possibly occur), then the intended benefits of making a distinction between current and future risks would be reduced.

A legitimate concern is whether the time would ever come when resources would be available for Class 11 sites. Would, for example, the continued discovery of Class I sites always preempt taking actions at Class II sites? Would political will and funding diminish for second priority actions'? Would the whole system move back to using impermanent remedies, converting current risks to future risks? These uncertainties cannot be completely removed. However, they should be compared with the probability that unless this risk distinction is made, the Superfund syndrome presented earlier will get worse and many sites will get worse from complete inattention. Honoring the national commitment to address Class 11 sites can be accomplished institutionally, for example, by keeping Class 11 sites on the NPL (not delisting them) or otherwise removing their visibility. Moreover, this option presumes site recontrol (controlling current exposures and preventing sites from getting worse) for Class 11 sites and that interim remedial actions (addressing current risks) for them fulfill the statutory preference for using treatment technologies.

On a more technical level, implementation could be made difficult by the quality of information and analysis during the history of a site. Site investigation is a continuing process which starts with the first evaluation of a site and continues throughout a site history until complete, final remedial cleanup is attained. Site risk classification must always be a professional judgment because qualitative or quantitative risk assessment is not a precise science, no matter who practices it. But it would be useful for successful implementation of this option if EPA provided more refined guidance for the conduct of risk assessments and made the analytic procedure more consistent by users in order to reduce variations in risk estimates (this is also important for Option 4).

Another potential problem is that communities might insist on more and more site investigations to prove a site would be safe as a Class II, thus effectively keeping sites in Class I. EPA needs to document its case for Class II designation with care. Conversely, certain safeguards from a community perspective are necessary. For example, assignment to Class II in EPA's official decision document could be subject to an appeal process. Moreover, assignment to Class II would not preclude a community from receiving a Technical Assistance Grant under Superfund. And there could be a formal procedure for petitioning reclassification to Class Ion the basis of new information obtained by parties other than EPA.

As information increases and becomes more complete and accurate, the assessment of whether the chief risks are current or future may change. Moreover, many factors not directly associated

[32] New Jersey Division of Water Resources/Hazardous Waste Programs Case Management Committee, *Case Management Strategy Manual*, draft, *May* 1989.

with the site, but which affect exposures—such as nearby residential development—and, therefore, risks may also change over time. These too must be a basis for reassessing site risk classification.[33]

Another implementation issue is whether this option would pose a serious obstacle to the government's obtaining complete payment of cleanup costs from responsible parties. Action would not have to be deferred because of future risk classification if one or more responsible parties are able and willing to pay for the necessary cleanup. But communities could see this penalizing fund financed deferred cleanups. Payment of an upfront cash premium to cover future costs for deferred cleanups is also possible (see Option 15).

Implementation could be thwarted because the States have the power to withhold the legally required 10 percent match for fund-financed cleanups. For example, a State could make cleanup of a Class I site impossible, even though EPA deemed it a high priority, and could offer **matching** funds for a Class II site for which EPA determined a sound basis for deferring action. This potential problem could probably be handled in most cases by negotiation between EPA and the highest levels of State government, if the public were kept informed. An example of this State authority being used in association with future risk recently occurred for the Saco Tannery Waste Pits site in Maine. The basis for EPA's original cleanup decision was future risk in the event of residential development. But, without viable responsible parties, the State wanted to reduce its cost. It convinced the EPA to switch from a $33.5 million cleanup based on chemical fixation of hazardous material to a $10 million one based on containment of the site, so it could save $2.35 million. The State must assure that no one will develop the site. EPA will avoid spending $21 million to address the future risk at the site.

OPTION 2: Establish a Federal Site Discovery Program

The Federal Government could establish a site discovery program whose mission was to identify chemically contaminated sites which may require cleanup, including those which might not be managed within the Superfund program. A number of different approaches have been used on a limited basis with results good enough to justify full-scale national application. In particular, there is a large inventory of historical aerial photographs and procedures for analyzing them can identify likely chemical waste sites which are no longer readily apparent.

Benefits: It is in the national interest to know the full scope of the cleanup problem as soon as possible. Only in this way can effective and efficient national strategies, policies, and programs be conceived and implemented. Setting sharper and more useful cleanup priorities requires that program managers understand what their current and future workload really is or will likely be. Moreover, the laws of nature—principally entropy—mean that undiscovered contaminated sites will become more difficult to clean up over time. Contaminants will leave their original containers or places of disposal, spread into the environment, increasing the size and complexity of cleanup. Money spent on site discovery would be relatively small compared to almost all other Superfund activities. For example, a site discovery program that started at $5 million per year and increased to say $25 million per year over 5 years pales in comparison to site

[33] Some people may view this with alarm because, for example, it suggests that a developer might intentionally locate a new residential community near a Class II site in order to obtain a Class I rating and a permanent cleanup which removes a disadvantage of the location (and increases its market value). Given the time and uncertainties for achieving complete cleanups, this is not likely to be a significant problem. Moreover, the government could take the position that until the new exposure situation existed the site remained Class 11; this would make it difficult to initiate and implement the new development. But it can also be argued that providing this kind of incentive for final remedial cleanup (or removing the disincentive for worthwile use of the land) is not without merit.

study and cleanup costs. Moreover, identifying a few serious sites a year and taking early cleanup action could pay for the entire program several times over in reduced cleanup costs.

Implementation: Current cleanup staffs resist site discovery for different reasons. Adding more sites to the program makes achieving success and meeting performance goals seem more difficult; and discovering new serious cleanup sites also challenges conventional wisdom that the worst sites are already known (which OTA shows to be incorrect in ch. 2). EPA has resisted a formal site discovery program in part because sites would be identified which would not necessarily qualify for cleanup by Superfund. However, this should not block a site discovery program, because knowing what the appropriate cleanup program is cannot be determined until the sites are identified and assessed. This option requires congressional and EPA commitment, consistent with a long-term national cleanup program.

OPTION 3: Use Environmental Criteria to Eliminate Sites at PA and SI Screening Stages

Bureaucratic criteria now being used to control the flow of sites into and through the program, in order to achieve performance goals and meet resource constraints, would be replaced by environmental criteria. Instead of a site being judged-on the basis of very sparse information-to be contaminated **enough** to merit attention by Superfund, the critical decision would be whether or not the site appeared to require cleanup. **There is no information or analysis to support the contention that sites eliminated from the Superfund program that may require some degree of cleanup will receive adequate attention from other cleanup programs.** The presumption in this option is that a site eliminated from Superfund is not assured of cleanup elsewhere. Indeed, getting cleanup attention elsewhere is made difficult by: 1) the stigma of being eliminated from the Superfund program, and 2) the demand for resources in other programs to address the many sites which do make it through the Superfund system and on to the NPL. (For example, States must provide matching funds for government-financed cleanups and may have insufficient funds to carry out all other cleanups; responsible parties **and** Federal agencies would naturally devote resources to required cleanups.)

Benefits: Improving public confidence in Superfund and reducing public outrage requires that key program decisions be based on sound environmental thinking. Over time, by creating excessive flexibility, Superfund's management has met resource constraints, in part, by **bureaucratically** controlling the workload of the program. If Superfund is primarily a public health program, then it ought to employ standard thinking used in health screening. This means having as much, if not more concern, for false negative findings in the earliest stages of Superfund than for false positive ones. That is, making certain that sites which really do require cleanup are not eliminated should be of paramount concern to the government. Letting sites through which really do **not** require cleanup is important because money could be wasted, perhaps preventing action at sites which really require cleanup. However, subsequent site work can and sometimes does reveal the false positive problem. But a site falsely eliminated from Superfund may never be rediscovered—until, that is, the problem becomes evident through damage to health or environment.

Implementation: This option probably requires statutory direction to EPA. The key issue is the need to let sites proceed through the system until reliable information and its analysis can be used to make an environmentally sound decision about the need for cleanup.

OPTION 4: Remove Range of Acceptable Risk Objectives

Because environmental standards currently exist for only a tiny fraction of cleanup situations, especially for safe limits of contaminants in soil, EPA has appropriately used risk assessment as a means to set cleanup levels. However, the current broad range of acceptable risk (expressed as above normal deaths in a population), from 1 in 10,000 to 1 in 10 million poses opportunities to compromise environmental protection at sites and to have inconsistent cleanups nationwide.[34] With this option, the range would be replaced by a single value.[35]

What that value should be deserves attention beyond the scope of this study; however, it appears that a value of 1 in 1 million with a variance procedure is most consistent with current decisions. Moreover, the inherent limits to current practice (e.g., examining only indicator contaminants for which health effects data exist), and the need for a margin of safety relative to the considerable uncertainties of risk assessment support this level of risk. Yet another reason for a margin of safety is that whatever a cleanup objective is set at, corresponding to a risk of 1 in 1 million (e.g., concentration of contaminants in soil), the actual cleanup will have some statistical spread around that target. Some people may believe that this level of risk is overly stringent, but the popular belief that risk assessment is intrinsically overly conservative has recently been shown to be inaccurate.[36]

It should also be understood that the risk considered here refers to individual risk, not total population risk. This option presumes, of course, that explicit cleanup goals or standards for a site are set. But, in fact, this is not the case for many sites. One problem is that many cleanups are implicitly based on cleanup technology performance, for whatever cleanup technology is selected, which most of the time is not one based on destruction of hazardous material. Another way of seeing this current form of implementation is that there often is no explicit risk reduction identified as the goal of cleanup.

Benefits: Removing environmental protection as a variable in cleanup decisions can improve public confidence in Superfund. Current excessive flexibility would be reduced. From a long-term perspective, reducing cleanup costs through lowering of cleanup levels is not consistent with the basic environmental mission of Superfund. When circumstances exist to use a higher level of acceptable risk, then they should be articulated by the government and defended on technical or fund-balancing grounds. Using a single acceptable level of risk also offers an opportunity for more certainty in the operation of Superfund. It removes one issue over which there sometimes is considerable

---

[34] A recent examination of cleanup levels said, "'. . . if the allowable level of risk is not held constant, "How Clean Is Clean?' levels become 'moving targets' and the probability that they will be applied inconsistently increases significantly. D. Killian, "'How Clean Is Clean?' contaminant remediation levels in soil," in *Management of Hazardous Materials* aria' *Wastes: Treatment, Minimization and Environmental Impacts.* Edited by S.K. Majumdar, E.W. Miller and R.F. Schmalz, 1989, The Pennsylvania Academy of Science.

[35] According to EPA, it has not used the lowest end of the risk range (i.e., 1 in 10 million). Moreover, in defending why the range should not be narrowed by reducing the lowest risk by a factor of 10 (to 1 in 1 million), as desired by the Office of Management and Budget to prevent higher cost cleanups, EPA also noted that its risk range "has not been a point of contention" with responsible parties. (EPA internal memorandum, identified as the notes of former Assistant Administrator J. Winston Porter, Sept. 30, 1988, in Committee Print 101-B, Subcommittee on Oversight and Investigations, House Committee on Energy and Commerce, March 1989.) Why was EPA successful in convincing OMB to keep the original risk range? EPA told OMB that removing the lowest risk, which it had not used, would, however, lead to a '" firestorm" which might 'destroy much of [its] flexibility. But the flexibility referred to by EPA was at the opposite end of the risk range; that is, higher risks (i.e., less than 1 in 1 million) have been used by EPA and sometimes have been important in selecting remedies with lower costs which have facilitated settlements with responsible parties. Selecting higher risk levels has been a point of contention with site communities.

[36] John C. Bailar, III, et al., "One-Hit Models of Carcinogenesis: Conservative or Not?" *Risk Analysis,* vol. 8, No. 4, 1988. The study found that underestimation of risk occurs in about 2.5 to 4 percent of the cases, and overestimates occur in about 5 to 7 percent of the cases. This paper has been instrumental in supporting the position that risk assessments of chemical hazards are not necessarily substantially conservative. In the case of vinyl chloride, for example, standard risk assessment methodology underestimated risk by a factor of 9.

confrontation and costly delay. This option, however, offers no benefits relative to cleanup decisions for sites posing threats from substances which cause health effects other than cancer and threats which are not now described in terms of numerical risks, such as threats to sensitive environments.

Implementation: Action by Congress seems necessary for such a critical policy change. Because of the sensitivity of the issue of not only selecting a specific level of risk, but of selecting what that risk is, it might be useful to begin with an independent study. The study would examine the issue and provide a recommendation for a national risk level for cleanup based on health and environmental protection criteria only. The National Research Council has performed a number of relevant studies in the past, such as on risk assessment and the Oak Ridge National Laboratory has performed very detailed work on the use of risk assessment in Superfund.

A major concern about this option, especially from responsible parties and government officials, is the inevitable loss of flexibility in determining site cleanup objectives. But to people living near Superfund sites, flexibility has meant the ability to legally reduce the stringency of cleanup in order to secure funding from either the government or responsible parties. In other words, the current range of acceptable risk automatically ***makes*** it legal to offer varying degrees of protection to people without explicitly explaining why that is appropriate or necessary. The public is especially sensitive to less stringent cleanups based on higher than normal (for Superfund) risk levels, because normally no benefits to the community are lost by demanding the most stringent cleanup. (One exception, which has occurred at several Superfund sites, is when a responsible party is also a major employer in a community.)

Another potential problem is that the inherent lack of precision in risk assessment and its susceptibility to subtle manipulation could make the use of a single value of acceptable risk ineffective. Refining guidance on risk assessment methodology to tighten its application, therefore, should be part of any study on this option.

Some consideration should also probably be given to the question of whether estimating risks at Superfund sites should take into account exposures to similar hazardous substances from nearby sources. For example, there may be other cleanup sites nearby. Or the government Toxic Release Inventory database obtained under Title III of SARA could be used to factor in exposures from industrial operations. It is difficult, from a health protection perspective, to judge cleanup need or extent in isolation, ignoring other exposures which, in some cases, might make the critical difference between cleanup or no cleanup, or affect cleanup standards significantly. This option does not preclude following the current statutory requirement to use applicable or relevant and appropriate regulations (ARARs), which, however, do not cover many contaminants and exposure routes at Superfund sites. Finally, the use of national cleanup standards, particularly for soil cleanup, is another way to achieve certainty and efficiency by stepping outside of the risk assessment methodology (see Option 5).

OPTION 5: Establish National Minimum Cleanup Standards

All cleanups of chemically contaminated sites, performed by any public or private entity, would have to comply with minimum Federal requirements comparable to those of Superfund. All available information indicates that very different procedures, actions, and results are occurring in different Federal, State, and private cleanup programs. For example, the use of land disposal is far more prevalent outside of Superfund (see ch. 4), the influence of those paying for cleanup on decisions about the scope and level of cleanup appears more significant in programs

outside Superfund, and substantially different levels of residual contamination in soil and water pervade the national cleanup system. Federal requirements could include, for example: compliance with existing Federal numerical standards for safe levels of contamination in air, water, and soil when they exist, unless more stringent standards have been set by the State; setting numerical standards for cleanup goals of major types of contaminants unless a waiver was granted in response to a detailed environmental justification for so doing (e.g., acceptable residual levels in soil of lead, PCBs, and creosote chemicals); use of standard exposure and risk assessment methodology and acceptable level(s) or risk to establish cleanup objectives; the preference for permanent onsite treatment remedies; use of a Superfund hierarchy of cleanup technologies and methods; use of cost-effectiveness analysis as a means to minimize site cleanup costs after determination of site cleanup goals; full public participation from start to finish of the cleanup process; and 5-year reviews of sites where contamination remains.

Benefits: National standards would introduce consistency and certainty into the national cleanup effort. Excessive flexibility would be reduced. The flight from Superfund would largely be stopped and, therefore, **sites deferred out of Superfund would not be penalized by receiving less stringent cleanups;** this would also reduce future Superfund needs.[37] Those paying for cleanups, including all types of government agencies and companies, would have: 1) less incentive to shop around for a cleanup program which posed the least stringent requirements and, hence, minimized their costs, and 2) less trouble and costs dealing with different cleanup programs with different cleanup standards or procedures in obtaining them. **The current inequality and inconsistency in the array of cleanups nationwide, often providing uncertain, incomplete, and ineffective protection of health and environment would largely be eliminated.** Many studies, particularly risk assessments, could be eliminated because fixed cleanup standards could be used. Conversely, national standards could also reduce excessive cleanups, as well as reducing transaction costs by reducing confrontation over cleanup goals at sites and shifting of sites among different cleanup programs (see ch. **4).**

Eventually, this option would make it more feasible to shift implementation of Superfund to States (see Option 19), because of the assurance that their programs would provide comparable protection. State officials have concluded:

> The lack of development of cleanup standards or goals has been a major impediment in achieving a more rapid remediation of hazardous waste sites throughout the country. The ARAR concept is good, but States have looked to EPA for guidance in the development of national standards or models for the establishment of site specific cleanup goals without receiving much meaningful assistance. The National Superfund Program Strategy must include a commitment by EPA to develop, in conjunction with the States, tools to generically answer the question "How Clean is Clean?" . . . The overall goal of developing cleanup standards, models, and criteria should be to assure a consistent approach to the cleanup of hazardous waste sites.[38]

Implementation: This option requires statutory enactment. **Many parties would find this option objectionable because of, for example: losing flexibility, facing increased costs, and facing the need to make initial changes in existing State statutes, regulations, and programs. In** other words, implementation would be difficult and opposition to the option substan-

[37] At a Senate hearing on June 15, 1989 the EPA Administrator indicated that the agency would not pursue at that time its deferral proposal as part of the new NCP. The reasoning was that cleanups for sites deferred to other programs could not be assured to offer the same kind of remedies, standards, and procedures found in Superfund. Response of William K. Reilly to question from Senator Lautenberg; Superfund oversight hearing, Senate Subcommittee on Superfund, Ocean and Water Protection, June *15, 1989.*

[38] Association of State and Territorial Solid Waste Management officials, Washington, DC., position paper "Non Superfund Program Strategy—Getting More Done With Limited Public Funds," Apr. 28, 1989.

tial, as any such Federal environmental legislation has historically been. Actual implementation problems and costs would depend on the exact requirements, their enforcement, and on penalties for noncompliance, as well as incentives which might be used to motivate compliance. Analysis of these details is beyond the scope of this study, but implementation problems could be minimized by keeping requirements as simple as possible. **OTA concludes that the potential environmental and economic benefits justify serious consideration of this option for a permanent national cleanup effort.** A first step by Congress might be to have a l-year independent study of this option by, for example, the National Academy of Sciences or a university with experience in the cleanup area, such as the federally sponsored program at the Center for Environmental Management at Tufts University. One issue requiring study is the extent to which numerical cleanup standards for soils would define a very large universe of potential cleanup sites (e.g., areas near highways with heavy metal contamination).

OPTION 6: Define and Limit Meaning of Permanent Cleanup

Superfund is necessary because of past shortsighted waste management practices. **The idea of achieving a permanent cleanup has intrinsic merit. But "permanent cleanup" is not now well defined by statute or EPA policy.** However, EPA has recently explained the role of treatment technology, which according to OTA is the means of achieving permanence, versus containment technology, which according to OTA is not a permanent remedy. EPA said that treatment technology "will be used most often for highly toxic, highly mobile waste, whereas containment is generally reserved for low concentrations of toxic materials or relatively immobile wastes. '[39] This position makes containment an acceptable remedy for many types of sites, especially ones with soil contamination and low levels of groundwater contamination. (Moreover, EPA's application of the land disposal restrictions under the RCRA regulatory program to Superfund essentially promotes leaving hazardous site material in place and capping it, instead of treating the hazardous material or even containing it in a RCRA hazardous waste landfill with liners and leachate collection.[40]) In fact, EPA has indirectly defined sites for which the statutory preference for permanent remedy applies and sites for which it does not, a distinction the statute does not make. If permanence is not an overarching cleanup goal, then lower cost, impermanent remedies are likely to prevail; in the past 2 years at least 75 percent of selected remedies are impermanent, according to OTA's definition of permanent remedy (i.e., destruction or recovery of hazardous material). (See ch. 3.)

With this option, permanence would mean that cleanup objectives are achieved without further action at the original site or at any other site which has become a part of the cleanup, such as an offsite landfill that receives cleanup waste. People living near sites want to feel confident that there are not enough toxic chemicals left in land or water to threaten their health. Conversely, impermanent cleanup means--or should mean-permanent contamination of land or water, because hazardous substances remain hazardous and a potential threat through uncontrolled release or exposure. (Unlike radioactive materials, there is no natural predictable decay of the hazardous characteristics of chemical waste.)

---

[39] EPA Memorandum, ''Advancing the Use of Treatment Technologies for Superfund Remedies, OSWER Directive No. 9355.0-26, Feb. 21, 1989.

[40] Environmental Protection Agency, ''Policy for Superfund Compliance With the RCRA Land Disposal Restrictions, ' OSWER Directive 9347.1-02, Apr. 17, 1989 and "Land Diposal Restrictions as Relevant and Appropriate Requirements for CERCLA contaminated Soil and Debris, " OSWER Directive No, 9347.2-01, June 5, 1989. See discussion inch. 3.

Without definite cleanup goals it is impossible to know whether any action is permanent. Permanence does not imply reaching zero contamination or zero risk. Cleanup standards that are less protective of public health and environment make it easier to achieve permanence. But certain kinds of action are inconsistent with permanence, including any form of land disposal or containment, and any use of engineering or institutional controls, including long term monitoring for releases. All of these mean: 1) site hazardous material remains hazardous; 2) there is uncertainty about releases of hazardous material and, therefore, risks to health and environment; and 3) there are a host of uncontrollable possible future events which might compromise the effectiveness of the protection. Some important examples of problems are: deed restrictions which later are forgotten, ignored or overturned; physical failure of caps on buried waste which goes undetected or, even if known about, is not effectively and expeditiously dealt with by repair or replacement because of lack of money or confusion over who has responsibility; new commercial or residential uses of land or water which were not anticipated and which cannot be blocked legally; natural catastrophes, such as flooding of a capped landflll or a lightening hit on a leachate treatment system; monitoring systems which may fail, may not be operated properly, may not be properly maintained with required sensitivities, and may not be responded to with fast and effective remedial action.

OTA concludes that it is not technically correct to convert the concept of permanence into a variable parameter. That is, **OTA disagrees with the notion that land disposal or engineering or institutional controls provide a "degree of permanence."** What **varies is the** level of protection provided by different cleanup technologies and methods, not the degree of permanence. To tell the public that a remedy is permanent for perhaps a decade does not build public confidence. **However, impermanent actions have an important role to play in decontrolling sites to reduce or even eliminate current risks without, necessarily, producing a complete and permanent cleanup.**

Benefits: Current statutory provisions are too ambiguous and lack the clarity necessary for effective program management. With this option Congress could establish a clear policy for Superfund management and reduce excessive flexibility, that now is enjoyed by EPA staff. **OTA concludes that there is a net benefit to focusing on achieving permanence through reduction of the cause of the intrinsic hazard, such as toxicity, compared to current statutory attention to reducing mobility and volume.** Scientifically, reducing mobility is not achievable through techniques which offer certain long-term effectiveness on a par with destruction; reducing volume of hazardous material usually results from application of a technology which concentrates the truly hazardous component of some larger volume of soil or water or non-hazardous waste and, therefore, is not on a par environmentally with reducing hazard through destruction or recovery of valuable material.

The public intuitively understands the environmental, economic, and psychological benefits of a permanent cleanup. Permanent cleanups offer more certain and more effective environmental protection and can prevent future cleanup costs. But many cleanups have not and cannot, with available technology and resources, completely eliminate the source of the problem. Still, public confidence in Superfund and EPA's implementation of it would benefit substantially from a commitment to achieving permanent remedies. And the public can understand that achieving permanence for all Superfund sites (currently known and yet to be identified) is not technically or economically feasible in the near or even mid-term.

Under current statute, 5-year reviews are necessary when hazardous material remains

onsite and many RODS acknowledge that future requirement. Whenever that requirement is invoked, the remedy is not permanent. (Nor is a remedy necessarily permanent if this provision is not invoked.) Current policy, however, means such sites can be delisted from the NPL. With this option such delisting would not occur.

Implementation: EPA could implement part of this option through revised policy and, if the current proposed NCP becomes final, through a regulatory change. However, because of the wide difference between past congressional actions and EPA interpretations, congressional action may be advisable. It would be difficult for EPA to implement this option without thoroughly revising its nine criteria for remedy selection. **Moreover, current statutory language about reducing toxicity, volume, or mobility through treatment as a cleanup preference must be addressed for complete implementation of this option.**

There would be major impacts on remedy selection and delisting which would raise concerns about implementation of this approach (see Option **22). The** trend of moving away from land disposal to treatment would become stronger, and the diverse set of treatment technologies would take on a different meaning. **Only some treatment technologies offer permanence (see *ch.* 3).** Costs might increase significantly in the short term. But R&D, technology demonstration, and competition would probably reduce costs in the longer term.[41] Increasing competition among an increasing number of destruction technologies and, for example, mobile incinerators, have already reduced costs. More effective separation technologies, which concentrate hazardous material for recovery or treatment by destruction technology, have also emerged rapidly and will continue to expand.

Implementation of this option could be made difficult because of the power States have in withholding their legally required 10 percent match for fund-financed cleanups, EPA may want to use a permanent but more expensive remedy at a site, but the State may only provide their matching funds for a lower cost, impermanent remedy. Indeed, this has happened already. One solution is for senior EPA officials to make this situation *known* to the public and to appeal such actions to the highest State officials.

Finally, this option can make use of the concept of Option 1, current versus future, uncertain risk. If there is an identifiable future, uncertain risk, the cleanup achieved to date may not be fully complete, even though a permanent treatment technology has been used. In such a cases, the remedy might be classified as an interim action and a permanent remedy might—or might not—be needed later.

Developing Workers and Technologies

OPTION 7: Reduce Dependency on Contractors, Expand EPA Workforce

Superfund implementation will always make extensive use of private sector contractors. But the current degree of dependence on contractors seems too high and, with this option, would be reduced. Too much dependence on contractors means a lack of **independent** technical expertise and information in government. **Improved public confidence in Superfund is contingent on the public believing that government workers, working in the public interest, know enough to solve cleanup problems.** The previous option as well as several others above also address this problem. Another aspect of contractor dependency is the use of contractors for inherently governmental work, particularly policy development and program implementation. Inevitably, reducing contractor dependence means

[41] EPA Currently uses figures which indicate that total site cleanup costs, including EPA's administration of the program, total about $30 million on average. OTA believes that implementation of this and some other options discussed in this report might increase the average site cleanup cost to $50 million, although variations among sites would remain very large. But this is really a worst-case scenario, because technological innovations and program restructuring, as discussed in the policy options of this report, could prevent such a large increase in average site cleanup cost.

20-011 0 - 89 - 2 : QL 3

recognizing that Superfund is a permanent program and, therefore, accepting the necessity to increase EPA's workforce at headquarters and in its regional offices. There is also a need to increase Superfund activities in EPA's Inspector General's office, a need presented in OTA's 1989 Background Paper on contractor use.

Benefits: The effectiveness and efficiency of Superfund in the near term depends, in some significant measure, on building up EPA's workforce and reducing the dependence on contractors. This option recognizes the absolute, permanent need to use private contractors in Superfund implementation. With this option, however, balance would be restored between the roles of government and private sector workers. Some of the dependency on private contractors could also be reduced if EPA would make greater use of other Federal agencies, including the U.S. Geological Survey, the Bureau of Mines, and the National laboratories (see Options **27 and 28).**

Implementation: EPA could implement this option with congressional support for shifting funds from contracting to building up the permanent EPA staff. This option does not imply a net increase in funding.

OPTION 8: Establish a Hierarchy of Cleanup Technologies and Methods

A possible hierarchy is given in box l-F. Using a hierarchy is meant to introduce an environmentally sound logic into the identification and evaluation of cleanup alternatives. For remedy selection decisions it means that it would be necessary to demonstrate that alternatives higher on the hierarchy than the one selected had been carefully considered, and the reasons for their elimination provided. It does not imply that specific cleanup technologies or methods would be required by the government, nor does it rule out combinations of technologies and methods which taken together may provide an effective site remedy. The hierarchy would establish destruction and recovery technology at the top of the hierarchy; this means that it is the most preferred, using permanence of remedy (or permanent **risk reduction) and certainty of that outcome as the ranking criteria.[42] For combinations** of technologies and methods, the one lowest on the hierarchy is key. For instance, reduced certainty places separation plus destruction lower on the hierarchy than just destruction. When separation technology is used first, its effectiveness determines the overall achievement of permanence; however, the combination of separation and destruction technologies can achieve a permanent site remedy. Lower on the hierarchy is land disposal, containment, and other engineering controls, followed by institutional controls, including ongoing monitoring and provision of alternate water. Relying on natural conditions (e.g., biodegradation in a contaminated aquifer) usually offers far more uncertainty than a controlled treatment process and can correctly be considered a form of no action. In some instances, separation technology alone may offer a permanent remedy because the collected and released hazardous material may be so low in concentration (after dispersion) that destruction technology is unnecessary environmentally and impractical (e.g., air emission of very small amounts of volatile organic chemicals from groundwater air stripping). But this variation is best characterized by a combination of separation and natural treatment.

Benefits: It would be helpful to achieve a better understanding of the functional differ-

[42] Some people maintain that technologies and methods which reduce mobility or exposure (and therefore risk) without destroying or recoving a site's hazardous substances offer comparable protection. OTA's finding, as discussed in ch. 3, however, is that the long-term certainty of protection is maximized what hazardous substances are destroyed or recovered. With other technologies and methods, the duration of effectiveness cannot be assured and they are impermanent remedies, but in some cases they maybe the only feasible options, and they are especially important for emergency, recontrol, and interim cleanup actions.

Box I-F--A Hierarchy of Preferred Cleanup Technologies and Methods

Purpcme-The hierarchy recognizes the **environmental preference for some** outcomes and types of uncertainties over others. Primarily, onsite permanent destruction or recovery **of hazardous substances is favored. Note that SARA's use of "or" with regard to reducing toxicity, mobility or volume is** inconsistent with a hierarchy of preferred environmental benefits. The hierarchy does **not guarantee that the highest** level of technology is used at **a specific site because other factors must enter into the analysis, especially the type of action (e.g., recontrol v. final remedy). But the hierarchy provides a consistent framework for studies and decisions. The following is a possible hierarchy of Preferred cleanup technologies and methods:**

Clam I: Destruction or Recovery-Actual destruction of hazardous organic substances to irreversibly eliminate the source of the problem. Examples: thermal, biological, and some chemical treatments (e.g., dechlrination). Recovery of pure metals or chemicals suitable for commercial use.

Class II: Separation Followed by Destruction--Technologies which separate hazardous from non-hazardous materials. Examples: **extraction or stripping of volatile chemicals from soil or groundwater, gas venting, soil washing and flushing, precipitation, and carbon absorption of contaminants from groundwater.**

Class 111: Stabilization-Any form of chemical fixation, stabilization, and solidification which cannot assure actual destruction of all hazardous components. There are numerous commercial forms which vary according to the materials mixed with the hazardous material. In some cases there are claims that organic molecules are permanently altered by the process, but this has not been well documented scientifically.[1] Effectiveness and reliability for toxic metals are well proven.

Class IV: Engineering Controls-A variety of methods can restrict the movement of contaminants or exposure to them. Although such methods are not permanent, they can recontrol a site by: 1) imposing physical barriers (e.g., slurry walls, landfill caps and liners, leachate or groundwater pumping); 2) keeping water away from hazardous material (e.g., diversion ditches, soil and plastic covers, storage vaults); and 3) keeping people away from hazardous material (e.g., fences, caps, and soil covers). Techniques in this class must be assessed routinely for failure or deterioration of materials. Repair and maintenance, as well as less than 100 percent effectiveness, pose unavoidable uncertainties. Onsite re-disposal of hazardous material, followed by engineering controls, provides more reliability than applying controls to hazardous material in their original condition (e.g., buried waste or contaminated soil).

Class V: Institutional Controls--These depend on people and organizatons to deal indirectly with hazardous contaminants by controlling exposures to them or by detecting the need for further action (e.g., restrictive deeds; alternate water supplies; relocation of residents; periodic monitoring, testing, or inspection). Unavoidable uncertaintiesrcsult from: l)potential failures of people or institutions to adequately fund or implement the controls, and 2) possible changes in the original cleanup objectives without public accountability.

Class VI: Natural Treatment-Any onsite or no-action approach which depends on a natural form of treatment being effective over the long-term (comparable to time over which hazardous properties persist) for expected but inevitably uncertain site conditions and future land and water use. Includes: natural biodegradation, chemical breakdown or decay of hazardous molecules, adsorption to soil. Dilution and dispersion of hazardous Substances into the environment which produce "safe" concentrations maybe considered by some people as natural treatment or attenuation.

---

[1] **In situ vitrification is** likely to **fall into this category because complete thermal destruction cannot be** assured (EPA's SITE **program** places it in **the stabilization category).**

NOTE: For classes I-III, the first preference is onsite treatment; second, in situ **treatment; third, transport and offsite treatment.**

SOURCE: Office of Technology Assessment, 1989.

ences among waste treatment technologies. Past effort has focused on the distinction-between treatment technology and land disposal and containment. **The hierarchy would reduce excessive program flexibility, introduce efficiencies into studies, help compliance** ***with statutory*** **requirements, help the public better understand analysis and selection of remedy,**

help channel government R&D and private sector technology R&D and commercialization into the most productive areas, and motivate technology developers to provide better data. In particular, in too many past Feasibility Studies, significant options high up on the hierarchy have not been thoroughly considered; this has blunted compliance with statutory preferences and requirements and it has caused community people to fight selected remedies which they correctly perceived to offer lower levels of protection.

Implementation: **There is no statutory obstacle** to EPA's implementation of this option. Alternatively, Congress could define the hierarchy and require EPA to implement the hierarchy in all implementation efforts. Although there are bound to be legitimate concerns, there seem to be no major obstacles to implementation. But questions may arise as to whether a technology destroys hazardous material, or how a technology gets classified when it destroys only some hazardous substances at a site, or about the labeling of a technology which destroys some hazardous material but produces new hazardous byproducts.

Destruction can be dealt with through scientific enquiry; proponents of a technology should have the burden of demonstrating scientifically, through experimental results, that hazardous substances have been rendered nonhazardous without the production of hazardous byproducts. (The rendering to a nonhazardous state does not necessarily imply the loss of original chemical identity; for example, some metals are only significantly toxic in one electronic valence state which can be changed through treatment.) Currently, without a good distinction between destruction or recovery and other types of treatment technologies, some companies are making unsubstantiated claims of permanence.

With regard to partial destruction or recovery of site materials by a particular technology, the first scientific principle should be that **no** destruction technology can destroy or recover **all** conceivable hazardous substances. Therefore every destruction technology has limits; for example, incineration cannot destroy toxic metals. The second scientific principle is that no process can operate with 100-percent" efficiency. That is, every destruction technology inevitably must provide information about hazardous emissions and residuals due to incomplete destruction. The third principle is that any destruction or recovery technology may produce **new** hazardous substances; this is a well-known aspect of incineration but an often neglected issue for other technologies, such as biological treatment.

The question of incomplete *site* contaminant destruction is another matter; it requires addressing the use of destruction technology relative to the quantity of all hazardous site material and the use of other cleanup technologies. Information should be presented on the relative contribution of different site cleanup technologies when they are intended to be used at roughly the same time; for example, at a site at which incineration and land disposal is used, information should reveal what fraction of the hazardous material-the actual hazardous substances, not the total volume of soil or water which may contain the hazardous substances—has been destroyed, versus the fraction land disposed. The degree of site contaminant destruction may often be maximized by using a combination of destruction technologies, or by a combination of separation and destruction technologies. Using separation first can reduce total costs substantially because destruction technologies are usually more expensive per ton processed than separation technologies.

Another issue is whether a *natural* form of treatment qualifies as destruction technology, or as presented here as the lowest, most uncertain option on the hierarchy. Here too, scientific analysis must be used. For example, it may be argued that natural adsorption of a chemical to site soil is treatment; perhaps, but that treatment is not destruction, it is a form of separation

technology. Moreover, it intrinsically has uncertainty, because soil conditions might change and reduce the adsorption, releasing the hazardous substance. Another important example, because it is frequently invoked in cleanups, is natural flushing. This means that water infiltrating contaminated soil removes contaminants and transports them away, typically into groundwater which may release the contaminants into a river. This too is a case of separation technology, with uncertain cleanup effectiveness and uncertain environmental effects due to subsequent exposures; natural or solar evaporation of volatile chemicals is similar. An example of natural destruction is biological destruction of an organic contaminant by naturally occurring microbes, in soil or groundwater, without, however, engineering controls to ensure continued effectiveness. Natural treatment may sometimes be used to make no-action seem more than it really is.

Adoption of the hierarchy does not impose options, but it does make it more difficult to choose an option low on the hierarchy without careful explanation of why ones above it have not been used. It is important to recognize that for some cleanup actions lower level options are appropriate, especially for emergency and recontrol actions.

Lastly, the impact of the hierarchy on treatability testing may raise concerns. Although treatability testing is critical to the maximum use of newer treatment technologies, the selection of specific technologies for evaluation remains an issue. The hierarchy would guide project managers in thinking about which technologies should be targeted for treatability testing. It is important to have representation of technologies from top to bottom, in case the most desirable one(s) are not found successful. In this way, the public can understand the **technical basis** of why more preferred technologies have not been selected.

OPTION 9: Restrict Use of Groundwater Cleanup Technology

The most common form of groundwater cleanup (other than providing alternate water) is pumping contaminated water to the surface and treating it through a variety of technologies, with the aim of rendering it suitable for use, discharge, or reinfection into the ground. But exactly when the program has substantially increased its use of pump and treat, research results and analyses have concluded that current practice does **not** offer predictable performance and success (see ch. 3) for complicated cleanups. Moreover, most decisions to clean up groundwater are for sites for which the government's analysis has shown no current risks, the source of the contamination has not been brought under control, and the underground aquifer is not yet well understood. **Although pump and treat can remove some contaminants, there is major uncertainty about the ultimate levels of contaminant reduction and the time to reach them. But this uncertainty is not communicated in RODS.** Over a year ago, a senior EPA official said:

> ... a recent analysis by EPA's own Office of Research and Development strongly indicates that the groundwater pump and treat systems, which the agency has been selecting to control groundwater contamination, will not achieve the levels of cleanup required by agency standards in less than tens, perhaps hundreds, of years, ., . [T]his new data illustrates that there is still a great deal to learn about how to remediate some of the problems at these Sites.[43]

With this option, Superfund management would reassess the current selection of pump and treat as a proven, predictable, and effective groundwater cleanup remedy for nearly all situations. This means examining ways to improve the practice of pump and treat, and alternatives to pump and treat, including point-of-use treatment, hydraulic containment of the plume, in situ biological treatment and other

[43]Gene A. Lucero, "Son of Superfund," *The Environmental Forum,* March/April 1989.

new **treatments, and natural attenuation and biodegradation. This** issue also highlights the need to pay more attention to identifying and eliminating the **source** of groundwater contamination at a site. **The greater the difficulty of cleaning up groundwater, the greater the urgency to remove the source of groundwater contamination.**

Benefits: The public's demand for action by Superfund is not well served in the long term by using an unreliable cleanup method. An enormous amount of money might better be spent on other sites, providing the public with more protection. Indeed, the current approach may be counterproductive environmentally. Expensive pump and treat cleanups may eventually be stopped because either the cleanup level is thought to be attained when in fact it has not been (e.g., because chemicals de-adsorb from subsurface soil), or because cleanup will be judged complete even though cleanup standards cannot be met (i.e., health effects standard is replaced by **a** technology performance standard). With this option, there would be more limited use of pump and treat, and more explicit institutional commitment to near-term monitoring and recontrol which, however, does not imply permanent cleanup.

Implementation: EPA could act on this option through, for example, a special high level task force study. Alternatively, Congress could require an independent study (perhaps by the U.S. Geological Survey which has developed improved pump and treat practices) which integrated the current state of scientific knowledge and the performance of current pump and treat practices at cleanup sites. The congressional route may be advisable, because EPA has shown little interest in addressing this issue, in part because of a natural tension between the Superfund program, with its primary interest in taking action, and the R&D program at EPA, with its primary interest in better understanding technology and its limits. Indeed, facing heavy public demand for action, it would be difficult for EPA on its own to shift away from the pump and treat approach, using it only when its effectiveness can be well substantiated (e.g., for contamination of a simple, well understood, and relatively small aquifer by only one chemical or a few similar contaminants).

Some people are concerned about underreaction to groundwater problems. But if spending large amounts of money on pump and treat at complicated sites is going to prove ultimately wasteful, then the public needs to understand that. If pump and treat is not a reliable permanent remedy for many types of sites, then it would be better to focus on recontrol actions to address current risks from groundwater contamination, careful monitoring of the problem, and the need for a major R&D program (see Policy Option 29). Moreover, it is possible to increase the chances for success of pump and treat by improving the technical methods used (see ch. 3), which mean increased costs.

OPTION 10: Establish Generic Site Assistance Program, Including Expert Systems

Groups of experts in generic types of cleanup sites (e.g., PCB, wood preserving, lead battery, municipal landfills) would be established at EPA headquarters. This means expertise centered around site problems rather than around cleanup technology (see following option). The key functions of the groups would be to: 1) provide technical assistance to front-line Superfund staff in EPA regional offices, Federal and State agencies, and contractors through telephone assistance, site visits, reviews of technical documents, and special reports; 2) develop and update expert systems (to replace or supplement technical guidance documents) for implementers to use on their own from the earliest site evaluations through assessment of the effective-

ness of a permanent remedy;[44] and 3) provide formal peer review of RODS prior to their regional approval and release.

Benefits: This option would provide an efficient way to use the greatest technical expertise present in the Superfund system, improving technical work and information transfer. Low quality and unnecessary site study work could be cut substantially because of the expert help and systems; indeed, with this option it becomes feasible in many cases for EPA to perform Remedial Investigations and Feasibility Studies on its own. The impact on the program of front-line staff turnover would be reduced, because there would be a stable core of technical expertise for site managers to draw on. This group of experts would also provide the mechanism for transferring information and technology from R&D efforts into the field. The public would be better assured that the best available cleanup technology was being selected by the government. Expert systems compensate for inexperience; they could also be very useful for educating members of the community, making their public participation more effective. The placement of this effort within the Superfund office and not EPA's Office of Research 'and Development is important. This effort is envisioned as operational, not research. Current use of ORD personnel for operational support detracts from ORD's primary mission.

An important benefit would be to provide a capability within government to assess the credibility and importance of technical information obtained by responsible parties. Currently, government spends a substantial amount of money on contractor work to duplicate site analyses or cleanup technology evaluations performed by responsible parties. This often means delay in cleanup and, very often, the government contractor work provides no new or different information.

Implementation: Either EPA or Congress could implement this option. The key to successful implementation is having the Nation's best technical experts, more so in science than engineering. This means people with major experience in investigating and cleaning up certain types of sites. OTA believes that many qualified experts already work for different EPA programs, such as in some of EPA's regional offices where they have accumulated many years of experience. Others are in universities, consulting firms, and some technology development companies. Work in this program could be seen as a rotating assignment, for EPA staff and for those in universities and elsewhere. The level of effort envisioned here is about 20 to 40 professionals administering this program; total annual spending would probably be in the range of $3 million to $5 million. But about $10 million might be necessary initially for development of several expert systems.

OPTION **11: Establish Technologies Assistance Program**

Groups of experts in generic technologies would be established at EPA headquarters; for example, incineration, biotechnology for soil cleanup, chemical fixation, low temperature soil stripping of organics, vacuum extraction of organics, groundwater cleanup. The groups of experts would provide operational assistance to site managers and staff by phone, personal visits, and quick reports in all phases of the program. The technology experts would be able to interpret new R&D results, as well as help design and interpret the results of site treatability tests (i.e., testing of site materials to evaluate effectiveness of a particular technology). They would stay abreast of all commercial developments and data, and provide an independent evaluation of vendor information. During design and implementation, they would also be available as consultants and trouble-shooters;

[44] The expert systems would be interactive computer software programs which should also be made available to communities, responsible parties, and the consulting engineering community.

they would also collect and analyze performance data from cleanup implementation. The experts would be the key instruments in transferring information from all government and industrial efforts to the front-line people implementing **Superfund. Teams** of experts could help regional site managers and staff resolve the difficult issue of what technologies or what combination of technologies could best be used **at** a site. This group would also provide another level of formal peer review of RODS prior to their regional approval and release.

Benefits: This option would improve the rate at which the best, most innovative, and cost-effective cleanup technologies were implemented. **It** would give the government much needed independent expertise cost-effectively, because it is impossible for site managers and staff in regional offices to be experts on a large number of very different, rapidly changing technologies. Moreover, OTA's research has shown that Superfund staff need to be less dependent on the expertise of vendors, contractors, and responsible parties. This option would help EPA conduct some of its own Feasibility Studies. Conflicts of interest which may affect key technology choices would be minimized. More consistency in Superfund implementation would also result, and the successes and failures of technologies would be quickly integrated into program implementation.

Implementation: The key to successful implementation by EPA is to assure that the highest caliber, experienced professionals are chosen for this critical task, more in engineering than science. OTA believes that many qualified experts already work for different EPA programs, such as in some of EPA's laboratories where they have accumulated many years of experience. Others are in universities, consulting fins, and some technology development companies. Work in this program could be a rotating assignment, for EPA staff and for those in universities and elsewhere. A key need is for **objective,** critical analysis and evaluation of information. In this regard, it is important that EPA personnel be totally committed to this work, as compared to current practice where some EPA experts provide technical assistance to Superfund staff on a part-time basis from their current home bases, such as in ORD. The level of effort envisioned here is about 20 to 40 professionals administering this program; total annual spending would probably in the range of $2 million to $4 million.

OPTION 12: Better Define Mission of SITE Technology Demonstration Program

This option would not change the basic premise of the SITE program; the need for the program remains. What appears necessary, however, is to make the program perform faster, be more user friendly, and be less bureaucratic. Moreover, the program needs a better focus on the demonstration of truly innovative technologies which seem too risky or uncertain for the private marketplace. This probably requires more sharing of cost and risk by the government. Too many of the technologies in the SITE program (21 out of the 30 technologies currently) have already had extensive private sector use and support. Attention would also be given to the need to say that a technology has not worked when it hasn't, and to minimize the use of SITE participation as a marketing tool, especially when SITE results do not fully support the claims of a vendor. Moreover, technology companies not in the SITE program should not be penalized by, for example, receiving less attention or support from EPA and Superfund staff. This option first means an independent evaluation of the SITE program by, for example, EPA's Science Advisory Board or the National Research Council. A short 6-month study would provide specific recommendations on how to improve the program.

Benefits: For a long-term cleanup program there are enormous benefits from the demonstration of innovative technologies which offer true breakthroughs in solving particularly difficult

and important cleanup problems, and also to produce substantial and even dramatic reductions in unit cleanup costs. Incremental technological improvements are well handled by the private sector, particularly because the cleanup market is so large and competition among and within generic technologies so intense. So the mission of the SITE program **should be to push the frontiers of cleanup technology.** The benefits, however, are questionable if the program competes with private sector efforts in promoting the demonstration and diffusion of more modest incremental technical improvements. With this option, current or anticipated spending levels for the SITE program might be **decreased,** because so much of the program's activities now have little to do with cutting edge, innovative technologies.

Implementation: EPA or Congress could require the study and specify its scope and objectives. The study should make use of detailed interviews with companies that have already participated in the program, with experts in cleanup implementation who are able to evaluate the types of technologies chosen for the program, and with academic experts in the areas of technological innovation and diffusion. Special attention should also be given to how sites have been selected for the program and whether the SITE technologies met a need that could not be satisfied by any currently available commercial technology.

Improving Government Management

OPTION 13: Use Generic Site Classification

A site classification system could be established and all existing sites and each site entering the Superfund system classified according to the best applicable generic description. **A relatively small number of site classes is possible; the types would focus on the origin and nature of site contamination.** Some feasible site classes are: wood preserving, pesticide, lead battery recycling, complex industrial manufacturing facility, PCB cleanup, municipal landfill, industrial landfill, solvent contaminated well field, asbestos, mixed heavy metals, and mining waste. All Superfund records, documents, and public notices would show a site's classification on a level of importance comparable to the site's name and location (e.g., site name, location, a municipal landfill).[45]

Benefits: This is a way to simplify the Superfund program and introduce management efficiencies. It also offers an opportunity for more certainty in the operation of Superfund by reducing excessive flexibility in key decisionmaking. **For too long, EPA has chosen to see every cleanup site as unique. While every site, like every person, may differ from others, it is also possible to see the important commonality within certain classes of sites.** Classification becomes critical for a large and growing cleanup program; it is based on the principle that much is learned over time about certain classes of sites and that transferring this expertise prevents unnecessary, redundant, and inconsistent work. Major amounts of repetitive contractor study work (particularly in the FS) could be eliminated, speeding up cleanups and reducing study costs; major regional inconsistencies for selection of cleanup standards and technologies could be eliminated. It is feasible to have generic protocols for all program activities based on site classification. Early classification of a site could also speed up removal and interim cleanup actions.

Implementation: Congress could statutorily require EPA to devise and implement a site classification system, or Congress could itself establish site classes. There are no major implementation obstacles; all current sites should be classified as well as new, incoming

[45]This system differs from the current designation in EPA's database which is not always applied, is less definitive, and is not used to simplify workload or to gain efficiency.

sites. One class would have to be something like "No Generic Classification" for sites which cannot be accurately fit into a generic category. When a site is first discovered or identified little information may exist and it might automatically be assigned NGC. But site classification should not be a rigid decision; as information on a site increases, its classification may change. The workload to apply a classification system to existing sites is relatively small; experienced EPA staff should take no more than 2 months to classify NPL sites and perhaps 1 year for all other sites in the system.

OPTION 14: Limit Responsible Parties to Implementation of Remedies

This option involves a major change in policy. EPA has sought and achieved substantial increases in the number of site studies (RIFSs) performed by responsible parties (actually by contractors they hire). More than half of site studies are being done by responsible parties with government oversight provided chiefly through government contractors (under EPA's Technical Enforcement Support contracts). One-third of all fiscal year 1988 RODS were for sites at which responsible parties conducted RIFSs. From June 1988 to June 1989, information from EPA indicates that there was about a 50-percent increase in the fraction of RIFSs conducted by responsible parties.[46] EPA has said that it wants to give responsible parties a larger role in defining site problems and evaluating cleanup alternatives. This approach offers the benefit of reducing the need for fund-financed studies and, to the extent that studies performed by responsible parties also promotes settlements with them to perform cleanups, also the benefit of reducing the need for fund-financed cleanups.

A study on the RIFS process done for EPA concluded that "Many of the RPMs [site managers] believe that the PRPs [potentially responsible parties] often seek the least expensive, rather than the best, clean-up techniques and are willing to expend considerable amounts of money in attempts to establish justification for the less expensive clean-up procedures. "[47] An earlier EPA headquarters study that examined the concern about risk assessments being different in enforcement actions, but which did not evaluate individual risk assessments, came to several pertinent conclusions: EPA regional staff believed that there was no difference between risk assessments prepared by EPA or responsible parties; about half the EPA regions ''recognizing PRPs' biased perspective and the 'malleability' of a risk assessment. . . have their contractors prepare all risk assessments, even if' PRPs are conducting the rest of the site investigation; and because of ineffective oversight EPA headquarters ''would not necessarily know if differences between Fund and Enforcement assessments are occurring. ' '[48]

With regard to the use of innovative cleanup technology, EPA has said that 'Difficult negotiations [with potentially responsible parties] are most likely where innovative technologies are proposed for sites where containment remedies are consistent with CERCLA mandates. PRP concerns generally focus on continued liability in the event of remedy failure, implementability problems, and cost. "[49] Thus EPA recognizes the tendency for responsible parties to favor containment remedies (see Option 6 and discus-

[46]This change appears to be related to EPA's desire to meet the congressional requirement in SARA for starting 275 RIFSs by October 1989 as well as the desire to reduce the demand on fund financed studies and cleanups. Another factor often brought up is that the more studies and cleanups performed by responsible parties the less the fund itself is used, making more money available from the fund for other cleanups. But it has also been noted that there has consistently been unused fund money which offsets the Federal deficit.

[47]Research Triangle Institute, *Outreach* initiative on *Superfund Remedial Investigation/Feasibility Study (RI/FS)*, Summer 1988.

[48]EPA, *Evaluation of the Preparation of* Risk *Assessments for Enforcement Activities,* September 1987.

[49]EPA Memorandum, ''Advancing *the* Use of Treatment Technologies fOr Superfund Remedies, ' OSWER Directive No. 9355,0-26, February21, 1989.

sions in ch. **3).** Also, EPA seems to acknowledge that the effectiveness of protection of health and environment is not a primary concern of responsible parties, but is the responsibility of the government.

In November 1988 a senior EPA enforcement official said:

> I am getting anecdotal information from a number of regions that some work being done by PRPs on RI/FSs is of substandard quality and is not being completed in a timely manner. . . . The most sensitive portion of the PRP work and the area that EPA must pay particular attention to is the remedial alternatives and the endangerment [risk] assessment portions of the RI/FS.[50]

More recently, EPA has acknowledged public concerns about this issue and has said the following:

> According to nearly all Regional managers and staff interviewed on this topic, many PRPs try to economize and propose only the most minimal remedial action. Some variations exist, of course; this characterization certainly does not apply to all PRPs. Nonetheless, EPA's basic approach to oversight must first assume that PRPs will try to conduct RI/FSs geared to their interests alone. . . . There was broad consensus among EPA managers and staff that the Agency needs to put more effort and resources into oversight of RI/FS performed by PRPs. . . . In light of the increasing number of PRP leads to be conducted in the coming months and the general concerns raised during this study . . . the task group believes that EPA must act quickly to upgrade current oversight practices and, in particular, involve *citizens* in this process.[51]

Responsible parties play a major role in many cleanups being conducted under the jurisdiction of States; the sites are not Superfund NPL sites, although many of them might qualify. A forthcoming GAO report on State cleanups says, "When private responsible parties clean up a non-NPL site, the state role in remedy selection is normally limited to reviewing and accepting or modifying a cleanup plan proposed by the responsible party. The state does not normally evaluate other alternatives or cost-effectiveness. " OTA agrees with the GAO assessment, State cleanups are not likely to offer environmental protection comparable to that required under Superfund. This is significant because the responsible party community has an interest in moving the Federal Superfund program in the direction of this type of interaction between responsible parties and government. The current rapid increase in the number of site studies and cleanups performed by responsible parties in Superfund stresses EPA's capabilities to exercise independent control over data acquisition, analyses, and cleanup actions.

The current policy, with its emphasis on having responsible parties conduct site studies, does not promote public confidence in Superfund for several reasons:

1. there is an intrinsic, potential conflict of interest because responsible parties have strong reasons to give as high or higher priority to minimizing study and cleanup costs than to stringency of cleanup;
2. responsible parties have an advantage over community groups in the pre-ROD stages of cleanup and can have greater impact on EPA RODs;
3. the current EPA oversight process, based nearly entirely on contractors and constrained by EPA's lack of experienced personnel and high workload, lacks public accountability and provides nearly no information to affected communities (e.g., critiques of responsible party contractor work);
4. there is so much inherent flexibility in EPA's policies and requirements as well as in many statutory preferences and

[50]Bruce M. Diamond, ''Tightening Up on Enforcement, ' paper presented at Superfund '88 conference, Washington, DC, November 1988.

[51]EPA, *A Management Review of the Superfund Program*, June 1989. This study considered but did not endorse disallowing responsible parties from conducting site studies. The recommendation was for closer oversight of private party studies, but improved oversight could be more expensive than the approach of OTA's option.

requirements that it is well within legally defined boundaries to select cleanup objectives and remedies at the low end of health and environmental protection; and

5. there is statistical and site-specific evidence (see ch. 3) that key EPA decisions on cleanup objectives and remedies are sometimes less stringent for sites when settlement with responsible parties is possible and sought by EPA as compared to government-paid site studies and cleanups.

The first two factors cannot be easily changed, but the last three factors could, theoretically, be removed with substantial improvements to EPA's workforce, policies, and requirements, as well as statutory changes (as suggested in many of the options in this report). Accomplishing the latter would take time, and only their successful implementation over time might create enough improvement in the Superfund system to restore public confidence and overcome public concerns about the first two factors. That is, the intrinsic potential for conflict of interest might become unimportant if the government's set of rules for studying sites, examining cleanup alternatives, and making key cleanup decisions, as well as its own technical expertise, reduced the risk of responsible parties biasing cleanup decisions to minimize cleanup costs. And the advantage of responsible parties over communities might in time be offset by an improved Technical Assistance Grants program and improved public participation activities by EPA. **As it now stands, however, OTA concludes that this option is one of the most important in this report for the Congress to consider.** Congress might also wish to consider limiting its implementation to perhaps 5 years, **at** which time Congress could assess whether it was still needed.

Responsible parties strongly oppose this option. They believe it critically important that they have the opportunity to conduct RIFSs. Responsible parties maintain that they have technical and project management expertise, often superior to and more stable than that of the government. And sometimes they do. They also maintain that they follow EPA guidance and regulations as well as statutory preferences and requirements. But, as discussed previously, excessive flexibility blunts the significance of compliance with government rules. They point to low-quality site studies done for the government and questionable cleanup decisions—which OTA has also identified-and maintain that they can do better work or ensure better contractor work for themselves. Moreover, they maintain that EPA provides significant oversight and retains the ultimate authority to make the key cleanup decisions in RODs.[52] Overall, responsible parties believe that they are ready to accept the responsibility assigned to them by the government and that responsibility should not be limited to providing money for or doing the cleanup. Nearly everyone acknowledges that providing responsible parties the opportunity to conduct site studies helps get settlements with them to perform post-ROD design studies and remedial actions.

With this option, responsible parties would no longer conduct site investigations or feasibility studies, and there would no longer be any remedial cleanup effort under the jurisdiction of an enforcement office.[53] Until the government itself concluded what problems had to be addressed and what remedies would be used, there would be no settlements with responsible parties for cleanup implementation, or formal or informal negotiations for settlements which discussed cleanup standards or remedies as negotiable issues.

[52] OTA has observed, however, that EPA's **RODS often** contain verbatim excerpts from responsible party study documents and frequently depend upon the data obtained in those studies. In other cases, EPA's contractors redo work performed for responsible parties.

[53] Responsible parties also include Federal agencies and States for some Superfund sites.

A key goal of this option is to balance the participation by responsible parties prior to RODS with that of site communities. That is, this option does not preclude responsible party activity at a site prior to the ROD, but it does transfer the official RIFS activity to the government. Responsible parties would still have the right to conduct their own studies if they desired and to contribute, *as communities do,* to the EPA site study and cleanup decision process. EPA site managers could consider information provided by responsible parties and use that information in significant ways, but the government would retain the principal responsibility for site investigation and evaluation of remedies.

With this option, the government would still retain its authorities to recover the costs of site studies from responsible parties or even to obtain agreements to pay such costs.

Benefits: This option would definitely improve public confidence in Superfund. Whatever the problems in having the government conduct site studies, with this option all such work would have public accountability and visibility. It seems as if, to some degree, EPA has addressed its workforce, contractor, and funding issues by privatizing site studies. But ultimately those issues must be addressed by the government without yielding its responsibilities to responsible parties and contractors.

If the contractor workforce is available to responsible parties to conduct studies, then it is also available to the government. The large amounts of money spent on oversight of responsible party studies-which can be as great as the costs of the studies themselves-would instead be spent on conducting the studies themselves.[54] There is considerable potential to reduce a lot of redundant contractor work in the current system. In its research on site studies and RODS, OTA has not found any consistently higher level of technical quality in studies performed by or for responsible parties. Although that may have been the case at one time, the recent growth of responsible party studies has met the same problems faced by EPA because of the explosive growth of Superfund. With this option, there is an opportunity for a net reduction in all contractor studies. This in turn could remove some of the pressure on the contractor workforce which now contributes to low-quality work and high costs.

A subtle benefit of this option is associated with another use of site studies. Completely objective and comprehensive RIFSs provide the public with an invaluable source of detailed information about a site which may contribute to the public's ability to pursue legal actions under common law because of personal injury or property damage. If a responsible party conducts an RIFS, certain kinds of information may not be obtained or may not be given in public documents. For example, the following advice was given to the responsible party community in the context of managing environmental claims:

> If a company believes that it could be susceptible to third-party suits either because data exist to show effects on neighboring wells or because there is a likelihood that the contamination could affect the neighboring wells in the future, further investigation may be an undesirable strategy. Action is called for, and any actions must fit in with the other aspects involved in overall claims management.[55]

[54] Since the oversight cost is generally paid for by responsible parties as agreed to in consent decrees, there could be a saving for responsible parties if they only pay for government studies, assuming that, *under this* option, the government would not pay more than the current total for responsible party contractor studies plus government contractor oversight work. A recent news story described two cases with high oversight study costs: the A.Y. McDonald Manufacturing Co. of Dubuque Iowa paid $279,000 for EPA's oversight contractor which was almost as much as the company paid for the cleanup, and the John Deere Dubuque Works paid more than $1 million for an EPA contractor to confirm that the $8 00,000 cleanup was working. Norm Brewer, "Another Iowa Businessman Raps 'Ridiculous' EPA Cleanup Costs, ' *The Des* Moines *Register*, June 15, 1989.

[55] Michael J. Murphy and Richard E. Freudenberger, ''Environmental Claims Management: A Case Study of Technical Support, in *Insurance Claims for Environmental Damages* (New York, NY: Executive Enterprises Publications, 1989).

In **other** words, the responsible party's interest in minimizing cleanup costs also extends to minimizing or avoiding other costs as well.

Implementation: Considering EPA's high interest in having more responsible party studies, this option would probably not be implemented without congressional action. A new statutory provision to override current language could preclude responsible parties from con**ducting site studies and limit settlements to implementation of government cleanup** decisions, from design studies through implementation. Cost recovery for government studies would still be encouraged. Clearly a current inducement for responsible parties to enter into voluntary or negotiated settlements with EPA is the opportunity to conduct RIFSs. Adopting this option, therefore, would make it all the more important for EPA to use the full array of strong enforcement tools provided it by statute. Moreover, if EPA provides effective participation in the pre-ROD process for responsible parties (as for communities) then the negative impact of this option on post-ROD settlements will be reduced. However, in the short term, this option would increase the need for spending significantly more fund money on RIFSs, but eventually these costs could be recovered.

A negative impact of this option on the duration of site studies and cleanups does not seem likely. OTA examined fiscal year 1988 RODS on a regional basis and found that in five regions fund sites moved faster from placement on the NPL to issuance of a ROD, and in five regions enforcement sites moved faster.[56] Nationwide, the average for enforcement sites was 4.0 years and for fund sites 3.9 years. OTA also analyzed EPA's data on RIFSs and remedial action projects in progress, which presented data on schedule performance from January 1,1987 through September 30, 1987;[57] 189 activities designated as responsible party lead averaged a delay of 1.7 quarters and 68 designated as fund-enforcement averaged 1.6 quarters, compared to an average delay of 1.1 quarters for 163 activities designated fund-financed.[58] For minimizing delays, these data indicate a potential advantage for shifting work from responsible parties to EPA.

However, the recent study *Coalition on Superfund Research Report* (September 1989) presented ' 'intriguing interim trends and conclusions' but cautioned against drawing broad national conclusions; 21 sites in Region 5 were examined, including 7 pre-SARA sites from 1984 and 1985. The study concluded that RIFSs performed by responsible parties were of equal quality to those by EPA, that sites move faster through the Superfund process when responsible parties conduct studies, and that cleanup standards are similar for the same type of sites for government financed and responsible party financed cleanups. All three conclusions are opposite to those of OTA's, which are based on examination of national data as well as a larger number of specific case studies in a number of EPA regions, all for 1987 or 1988. In the Coalition study, of the 6 sites that responsible parties performed the RIFS, 3 were from 1984 or 1985. Because Region 5 is large, the sites

[56] The most striking differences were: Region 6 where fired sites were 1 year faster; Region 7 where fund sites were 1.6 years faster; Region 10 where enforcement sites were 1 year faster. Nationwide, for enforcement sites, Regions 2 and 7 had the longest times (4.8 years) and Regions 3 and 6 the shortest times (3.4 and 3.5 years); for fund sites, Regions 1, 2,4, 8, and 10 had the longest times (4.6 to 4.8 years) and Region 6 the shortest time (2.5 years).

[57] This is a database over three times larger than FY88 RODS; 85 percent of the data covered over 450 RIFSs in progress and, therefore, these data suggest the possibility of discernible differences between fund and enforcement RODS released after FY88. EPA, ''Progress Toward Implementing Superfund: Fiscal Year 1987 Report to Congress-Appendix D Status of Active Remedial Investigations/Feasibility Studies and Remedial Actions in Progress on Sept. 30, 1987, " April 1989 [statutorily, the report was due on Jan. 1, 1988]. The data presented do not reveal delays which may have occurred prior to Jan. 1, 1987,

[58] Normally, responsible party lead activities would be placed in the enforcement category, We think that fund-enforcement activities mean that responsible parties have been identified and that the site is slated for enforcement action to subsequently obtain settlement for future work and cost recovery for work financed with the fund. Responsible party lead activities probably mean that responsible parties are conducting work agreed to as a result of a settlement and consent decree.

evaluated in the Coalition study are a small fraction of that region's output.

Overall, the key to successful implementation is improved EPA capabilities and procedures which **would assure that its site studies will be more effective, efficient, and consistent than they have been.** (A number of policy options identified in this report could assist that goal.) As noted above, implementation of this option could be for a limited time, perhaps 5 years, with the expectation that sufficient improvements in the program might make responsible party conduct of site studies less contentious.

OPTION 15: Reexamine Financing and Enforcement of Liabilities to Improve Environmental Performance

Superfund's environmental performance is affected by its financing and enforcement of statutory liabilities. To limit the amount of money for fund-financed studies and cleanups, Congress imposed very strict liabilities which would set the stage for major financing of cleanups by responsible parties. A number of strong enforcement powers were given to EPA and the Justice Department to ensure that responsible parties, if they could be identified, would pay for cleanups either before or after the fact. In large measure, the basic congressional strategy has worked, because responsible parties have probably provided several billion dollars for studies and cleanups. **OTA has not included 100 percent public financing (as for a public works program) without liabilities as an alternative to this basic congressional strategy. One of the more important reasons is that Superfund liabilities have been seen by nearly everyone as a powerful incentive to promote industrial waste reduction and improved waste management.**

But success has had several undesirable impacts: delayed studies and cleanups, added administrative and transaction costs for the government and responsible parties, and compromised environmental quality at some sites. These effects are an inevitable consequence of the natural confrontation between government goal of maximizing spending by responsible parties and responsible parties' goal of minimizing their costs. Delay and added administrative and transaction costs have also resulted from the reluctance of many responsible parties to actively participate and negotiate with the government. This, in turn, has resulted, in large measure, because EPA has not used some of the strongest enforcement powers given it by statute. That is, uncooperative responsible parties are not necessarily penalized. But some of the problem has to do with the difficulty of making a strong legal case. Thus EPAs preference for voluntary or negotiated settlements which is only one of several tactics given it by statute to implement the basic congressional strategy. Settlements have been promoted through: 1) allowing responsible parties to conduct RIFSs, and 2) implicitly or explicitly reducing the scope or extent of cleanup and selecting less permanent remedies to reduce costs at some sites.

With this option, Congress would reexamine how the mix of statutory tactics can best be used to implement the original congressional strategy (i.e., maximizing financing of cleanups by responsible parties) and obtaining stringent cleanups comparable to fund-financed ones. Principally, this means exploring: 1) using more government funds to act quickly at sites—implying increasing current special taxes or establishing new ones initially-followed by increased cost recovery; 2) using the stronger enforcement tools provided by statute to compel more responsible parties to pay for stringent cleanups; and 3) developing more effective incentives for voluntary settlements so that it is not necessary for EPA to compromise environmental goals.

For the first two tactical approaches, OTA's research has not yielded any new technical insights and congressional discussion of them will largely center on legal, financial, and

implementation issues. However, for the third tactical approach there is an idea debated, but rejected by Congress in 1986, which merits reexamination. Responsible parties have argued that giving them complete and final closure to the government's claim on them at a specific site would get more voluntary settlements and get them more expeditiously. Obtaining quick and certain closure has monetary value. The government could provide this settlement incentive: If the responsible party or parties pay a premium to the government—above the near-term estimated cost for cleanup--then the government will irreversibly close its case.[59] (EPA sometimes uses this approach today with de minimus responsible parties; i.e., those assigned a small fraction of a site's cleanup cost.) To lower its monetary risk with broad application, the government would have to have **a good** sense of what the ultimate complete cleanup might be and cost, taking into account uncertainties about site contamination, risks, cleanup objectives, and cleanup technologies. This may, however, not be feasible at all sites.

Benefits; Improving Superfund implementation requires the examination of all aspects of the program and, especially, their interactions. Giving the public the kind and amount of environmental protection it demands expeditiously is, inevitably, linked to Superfund's components relating to financing and enforcement of liabilities. Past and current tactics have provided some key financial benefits, but they have come at some environmental and monetary costs. OTA believes that there is no intrinsic conflict between the twin goals of obtaining expedient, comprehensive, and permanent environmental protection and making responsible parties pay for cleanup. The issue really is what mix of tactics best achieves both goals.

implementation: Congressional action is required. Although CERCLA already gives EPA some of the necessary statutory authority (e.g., enforcement tools and cost recovery), history has shown how contentious and difficult it is to deal with financing and enforcement of liability issues. The idea of responsible parties paying a premium to quickly reach complete and final closure at a site is actually an extension of something already implemented by EPA in a limited way. However, the release from future liability does not cover the discovery of new conditions or other extraordinary circumstances. These are not improbable events. Thus, the responsible party cannot obtain total protection from future liability. However, for complete elimination of future liability as considered in this option, Section 122(f) of the CERCLA/SARA statute would have to be changed. A critical policy issue for implementation of the premium option is: Would the public interest be served by giving responsible parties complete and total release from future payments and liability if they pay a special one-time premium?

The answer, of course, may depend on how well the government can identify what that premium should be. In 1986 making this determination was viewed as infeasible and the idea of allowing responsible parties to pay for a complete release was rejected. OTA's examination of many cleanup decisions and the development of new information at many sites during their cleanup leads us to conclude that it would be difficult to calculate a premium but not as infeasible at most sites as it seemed in 1986. Much experience has been gained through hundreds of remedy selections, remedial de-

[59] "The term 'risk premium payment' refers to a risk apportionment device similar to insurance premiums, under which the risk taken by the government for providing PRPs with a broader release from liability is offset by a payment in excess of the projected cost to complete the remedy, The premium should be sufficient to compensate EPA for taking the risks associated with contingent future costs, such as cost overruns in completing the selected remedy or future costs that may be incurred if the selected remedy is not adequately protective of human health and the environment. Robert J. Mason and Mark F. Johnson, "Structured Settlements: A New Settlement Incentive, " *Superfund* '88, proceedings of November 1988 conference, Hazardous Materials Research Institute, Silver Spring, MD.

signs, and remedial actions. A study could show the relationships between estimated costs in RODS and actual costs of implementing remedies (and some such work is underway). The distinction between current and future risks discussed above might also aid this effort. The example given in the discussion of Policy Option 1 (box l-D) is also instructive here. Although only a small amount of money would be associated with the immediate cleanup, a much larger sum would be necessary to address complete source control and groundwater cleanup in the future.

OTA believes that it is possible to estimate (with reasonable but not complete certainty) the costs of future cleanup at most sites and factor in the delay before future actions might take place. High eventual costs would be often offset by longer times before action is necessary, if at all, and low costs would usually be offset by a need to take action fairly soon. Too low a premium would result from higher than anticipated cleanup costs and/or costs that became necessary faster than anticipated; too high a premium would result from a lower than anticipated remedy cost and/or one more delayed than anticipated. (The premium situation described here is not unlike that facing insurance companies in setting life insurance premiums.)

Implementation of some of the other policy options presented in this report would help EPA estimate premiums, these include: site classification, defining permanence, using a hierarchy of cleanup methods, the site technical assistance program, and the technology technical assistance program. Uncertainty about future cleanup costs cannot be eliminated, but it can be reduced to reasonable levels for many sites and translated into risk premiums.

In terms of economic principles, there is a benefit for the government to get significant money upfront. In effect, premiums are like mini-trust funds for individual sites, covering future cleanup contingencies, and building value over time before they are needed. They are like life insurance premiums used by companies to earn money before payment is necessary. The government also might pay less for administrative and transaction costs when negotiating because a one-time premium may reduce the length and complexity of the settlement process or other, sometimes multiple, enforcement actions.

OPTION 16: Strengthen EPA Headquarters Direction and Oversight of Regional Implementation

There is little dispute that Superfund actions and program performance vary widely among EPA regions (see OTA's 1988 case study report and ch. 2). In its recent management review, EPA said that nearly 80 percent of fiscal year 1988 RODS, for example, used the agency's required nine criteria for selecting remedies. But the fact that over 20 percent of RODS did **not** use the agency's method for remedy selection indicates excessive regional autonomy. In checking the accuracy of information provided by EPA in its first report to Congress on Superfund implementation, EPA's Inspector General recently found "30 percent of removal activities and 13 percent of remedial activities claimed by the Regions were not supported by valid documentation in the Regions' files."[60] A recent study of Superfund examined this issue and concluded:

> In reality, the Administrator has little time to "manage" the Regional Administrators. As a result, they operate with considerable autonomy and, it appears, frequently without close adherence to national policy. [There is] a lack of clearly defined responsibility, authority and accountability between the Regions and Headquarters.[61]

[60] EPA, *Progress Toward implementing Superfund Fiscal Year 1987—Report to Congress,* April 1989.

[61] Clean Sites Inc., *Making Superfund Work,* January 1989.

The flexibility regions want competes with national consistency. With this option, EPA regional offices would still maintain primary implementation responsibility, but they would have less flexibility in interpreting or ignoring EPA policy and guidance. EPA headquarters would have a primary goal of national consistency for Superfund implementation. There would be routine examination of RODS and studies for inconsistent regional decisions, especially for cleanup standards and remedy selection.[62] ROD bunching at the end of the fiscal year and ROD inconsistencies for substance and format would be given special public attention. Deviations from program policy would be **identified, such as using design studies to** circumvent the need for treatability studies on alternative cleanup technologies during the pre-ROD study phase.

Benefits: This is a way to reduce excessive flexibility in program management, restore pub**lic** confidence in the program, and strengthen environmental performance. **There is no basis in law or policy for environmental protection depending on what region a Superfund site is in.** It is also a critical way to reduce unnecessarily high administrative and transaction costs for the government and the responsible party community. Reducing regional variation in the implementation of Superfund is key to having a single, truly national cleanup program. There is no inherent contradiction between the desire for central national policy and management versus the desire for regionalized implementation. **Regions could identify regional, State, and site specific conditions which merit special attention or different responses from the national norm.**

Implementation: **Regional managers and staff's are likely to resist this option. Finding a middle ground between the need for regional flexibility and central national control, however, is necessary if Superfund's performance is to be improved.** Theoretically, EPA could implement this option. But, considering the historical relationship between EPA headquarters and EPA regional offices, it may be advisable for Congress to explicitly require action by the EPA Administrator. For example, all key summary information on Superfund's performance could be required to be presented on a regional basis. The Administrator would identify significant differences among regions, the environmental impacts of those differences, and actions to address those differences and impacts. Special attention should be given to the impact of State laws and actions on regional departures from agency policies. Explicit and public evaluation of regional performance against nationwide, program objectives would also be required. Programs designed to rotate key regional people among regions to bring the poorest performing regions up to the level of the best performing regions might be required.

OPTION 17: Commit to a Permanent Superfund Program

As a matter of public policy, Sup-fund would be acknowledged to be a permanent program, requiring a national infrastructure and institutional delivery system. This means, for example, establishing: university programs to support a well-educated, stable workforce in government and the contracting industry; a continuing R&D effort; well-defined policies for short- and long-term priorities; effective inter-agency and Federal-State relationships; and central, national information systems. As a first step, Congress could consider requiring an independent study to: 1) assess whether and, if so, how current Superfund activities have been based on detailed long-term program needs and strategic objectives, and 2) identify specific policies, programs, and funding requirements to establish an effective national infrastructure for a permanent cleanup effort. The study would produce a long-range strategic plan for Super-

[62] Other program components, such as site evaluation, also need headquarters oversight and periodic assessment.

fund, identifying and discussing issues, needs, and policy options beyond the scope of this OTA study.

Benefits: Public confidence in Superfund would be improved by the government taking specific steps to ensure an effective long-term delivery system. It would help make public expectations for Superfund more realistic, and it would help the private sector in making efficient and effective contributions to the government effort.

Implementation: Congressional action is required. It could take the form of both a statutory policy statement and a series of specific program spending authorizations and appropriations. Broad public support is likely because it is in virtually everyone's interests to minimize future uncertainties.

OPTION 18: Establish an All Inclusive List of Cleanup Sites in the United States

The new list might be called the National Cleanup List and a new NCL office would be established at EPA to be a central, national clearinghouse for key information about sites for which some governmental agency had determined that cleanup was probably necessary.[63] This corresponds to the Superfund's National Priorities List. All cleanups of chemically contaminated sites would be tracked through the new NCL; Superfund sites would be a subset of the NCL and they could be designated as belonging to the National Priorities List. Twice a year, the office would issue a revised NCL document, made freely available to the public. By using a set of simple symbols, for example, the following important information could be presented for each site: what cleanup program the site was being managed in (e.g., Superfund, RCRA corrective action, a State program, a Federal agency); when the site first was recognized as requiring cleanup; what actions have been taken at the site (i.e., site investigation, emergency action, recontrol, interim or final cleanup) and when those actions were completed. Appendices in the report could provide names and telephone numbers of key government cleanup offices, and a list of sites which have received complete cleanups.

Benefits: Cleanup in America has not only grown, it has become increasingly fragmented among many different programs, making it increasingly difficult for anyone in or outside of government to have a good sense of the overall effort. This option would greatly improve public accountability. **A chief use of the NPL is to provide information to the public, but the current NPL covers only a small fraction of cleanup sites in America. This** option would inform the public about the relative contribution of Superfund compared to other cleanup programs. And from the perspective that sites in other cleanup programs may ultimately become Superfund sites because of less complete or less stringent cleanups than in Superfund, this option is important for a long-term Superfund program.

Moreover, there is relatively little information in the current NPL which really helps people understand what is going on at sites. With this option, the NCL would be become a quick-reference report card for cleanup sites. The NCL would become the key instrument for disseminating the results of a national clearinghouse for centrally collecting key facts about cleanup sites. The NCL office would also have the capability to provide important summary information to Congress and others about cleanup in America. Environmentally, there is bound to be increasing attention to *cumulative* exposures and risks; contaminated sites in different cleanup

[63] This is in contrast to a list of inventory sites; that is, sites which have been identified as possibly requiring cleanup but which ***require some assessment,*** inspection, and evaluation before determination of the need for cleanup. The number of inventory sites is much larger than the number of sites eventually determined to likely require cleanup. In Superfund, about 10 percent of examined inventory sites have become NPL sites. But 10 to 20 percent of the inventoried sites become the responsibility of other cleanup programs. Some estimates of the potential number of Superfund inventory sites reach hundreds of thousands of sites.

programs may be close enough to affect the same people. Determining safe levels of residual contamination in land or water may require accurate information on multiple cleanup sites as well as other sources of toxic chemicals, such as operating industries reporting information to the Toxic Release Inventory maintained by EPA under Title III of SARA.

Implementation: This **option requires statutory action by Congress, possibly including authority to obtain key information from ail cleanup programs in the nation. Implementation** of **this option would not in any way affect current statutory requirements for NPL sites. Establishing this new effort means more people and money.** But the effort would be relatively small, probably no more than 10 to 20 people could carry out this function; EPA already commits some resources to the administration of the NPL. Procedures would be established to receive information in a routine, periodic way from all cleanup programs. Total annual cost would be probably be in the range of $1 million to $2 million, including publishing and mailing NCL reports (the report could also be made available electronically). This cost would be balanced against the potential benefits of improving public information and confidence, as well as the help it could give to managers of all cleanup programs and companies in the cleanup business. A few States, such as Florida, now provide the kind of comprehensive and informative listing of sites considered in this option.

OPTION 19: Begin Examination of Moving Superfund Implementation Outside of EPA

Direct implementation of such a large-scale field activity is not, theoretically, what a regulatory agency is supposed to do. Moreover, Superfund implementation pits the environmental standard setting role of EPA against EPA's compliance with environmental standards. It is similar to asking EPA to build and operate, for example, hazardous waste landfills or incinerators. In fact, this fundamental problem helps account for the trend in EPA's management of Superfund to privatize the program as much as possible, through both the extensive use of private contractors and settlements with responsible parties. But there are other strategies to shift Superfund implementation away from EPA, leaving it to concentrate on setting cleanup standards and goals and ensuring compliance with them by all parties which perform cleanups.

Two main alternatives seem worth detailed examination, which is beyond the scope of this OTA study. First, Superfund implementation might be transferred to the States. A number of other EPA efforts have taken this route. On the plus side, the States are closest to the problem and, for the most part, want as much responsibility as they can get in implementing environmental programs, although that is usually contingent on obtaining substantial financial support from the Federal Government. On the negative side, State implementation of environmental programs has had mixed results, and the State participation in current Superfund implementation (through site specific cooperative agreements) also has not been especially successful. Moreover, although many States have significant cleanup programs of their own, there is very little detailed information to support a general conclusion that State implementation has been better than EPA's of Superfund. Still, State implementation of Superfund could be a longer term strategy, perhaps in about 10 years or more.

Second, Superfund implementation might be transferred to a new quasi-Federal agency, designed especially to carry out the national cleanup effort-perhaps including many other cleanup programs. The Federal Government has established new agencies in the past to implement a major national *technical* effort (e.g., National Aeronautics and Space Administration). Indeed, neither OTA nor others have been able to make a good case for using an existing Federal agency other than EPA for Superfund

implementation, even though, in theory, several of them seem qualified. The chief problem seems to be a lack of public confidence in those existing agencies to move beyond their current missions and undertake a major hazardous waste cleanup program (e.g., the Army Corps of Engineers, the Bureau of Reclamation) or the relatively small size and limited scope of the current organization (e.g., U.S. Geological Survey). Moreover, there are unique benefits of establishing a new quasi-Federal agency. In particular, it is a way to overcome many personnel constraints, especially the cap on Federal salaries for technical professionals in short supply.

Benefits: If Superfund is accepted to be a permanent program, then there are enough theoretical benefits for shifting implementation away from EPA to warrant a serious study of the option.

lmplementation: This option requires congressional action. The frost step would be a special, independent study delivered to Congress. It would focus on the costs and benefits of specific options, paying special attention to identifying transition problems and their solutions. Such a study could be done by a major university government or public policy center with some experience in the environmental area, and could take about 2 years. Another early action could be providing grants to States which submit proposals on how they would develop their resources in order to implement the Superfund program in the way EPA regional offices now do.

PART II: Program Changes

Setting Cleanup Priorities and Goals

OPTION 20: Use Hazard Ranking System in More Limited Way

The HRS (in its present or revised form) would no longer be seen as yielding numbers accurate to two decimal places and scores would no longer be assigned to NPL sites for their entire history. Instead, the HRS would be used as a binary decision tool: either a site poses a significant environmental problem which may require cleanup, or it does not. Years of research and analysis of the HRS has found that it cannot reliably make fine distinctions from site to site (see ch. 2). Its appropriate use is as an aid to early site decisions based on limited information. Instead of the current cutoff score of 28.50 for placement on the NPL, which was set on nonenvironmental grounds, two scores would be used: a high score above which a site certainly merits detailed examination and possible remedial cleanup, and a low score below which there is little chance of the site having a significant environmental problem. For sites with scores between these two critical scores, a panel of experts would make a consensus professional judgment as to whether the site does or does not get placed onto the NPL, on the basis of the information prepared for the site.

Benefits: This new use of the HRS would save a lot of effort and money which now goes into the determination, review, revision, and use of scores, which, in fact, serve little purpose. For example, in the shift from proposed to final status, scores are often changed very small amounts-amounts which make little sense in terms of the accuracy of the methodology nor in terms of how the scores are used. There is no evidence that EPA regions make important decisions about sites because of their precise scores. The chief priority-setting accomplished by the NPL is to distinguish between sites on the NPL and sites not on it. Site scores, however, have not set priorities among sites on the NPL. EPA's practice of changing site rankings on the growing NPL, based on site scores, serves no useful function. The extensive quality assurance/quality control efforts by government and contractor staffs is largely misdirected to achieve a false and unnecessary precision. Moreover, the use of a single score for the entire history of an NPL site doesn't mean much technically or environmentally. The score is determined when information on the site is at its early and worst

stage; the score is never changed on the basis of new and improved information, such as the eventual risk assessment, nor is it changed to reflect the environmental consequences of emergency, removal, or remedial cleanup actions at the site. To its credit, the Department of Defense updates its site scores to reflect changes in sites.

With this option, sites which may not now get on the NPL because of deficiencies in the HRS methodology would have a better chance of being placed on the NPL.

Implementation: EPA could do this on its own or Congress could direct it to make these changes through statute. There are no significant obstacles to implementation. Unnecessary work by government and contractor staff could be stopped. Some effort would be necessary to determine the two new high-low score boundaries. This could be done by EPA's Science Advisory Board, which has already done work on the HRS. This study could be done within 6 months; it should also recommend a standard form which would be filled out by the technical review panel in explaining its decision on a site.

The composition of the panel of technical review experts to make the decisions for sites with scores between the high-low boundaries should not be difficult. To make the application of the HRS efficient and timely, this group should be a permanent staff function at EPA headquarters (not a contractor activity). From three to six of EPA's most senior, experienced technical staff should be selected for this important function. The review panel should prepare its standard brief report on a site within 1 month of receiving the job; the panel should have the right to visit a site. Currently, regulatory rulemaking is used for site placement on the NPL, which carries with it many legal and procedural burdens, including challenges to HRS scores. However, this option would not require changing that procedure. Sites would be proposed on the basis of a score which exceeded the high-boundary score or the judgment of the review panel. Challenging EPA's decision would remain essentially the same as it is now.

OPTION 21: Reassess and Limit Use of Indicator Chemicals for Site Studies, Risk Assessments

The selection of indicator chemicals to study risks at sites merits more attention and public scrutiny. The purposes and technical appropriateness, in theory, of using indicator chemicals needs policy clarification. For example, the Oak Ridge National Laboratory study mentioned earlier found that 54 percent of RODS used no formal screening procedure for selection of indicator chemicals. This option would require an independent examination of current policy and procedure, and a detailed analysis of how indicator chemicals have been selected and used in critical site cleanup decisions. As a means of simplification and study cost reduction, using a short-list of representative site contaminants stands on its own merits. The problem lies in implementation of the concept, especially by relatively inexperienced people, and unintended uses of the short-list.

First, indicator chemicals used in risk assessment may not produce accurate risks because too many site contaminants are left out. The extent of this problem is linked to what concept of risk is employed. If risk assessment is centered around possible worst case individual risk, as it is currently, then using a short-list is less problematic, as long as the worst site contaminants in terms of health effects are chosen. However, if the risk concept is population risk, reflecting actual or likely total risks to a whole exposure group, then using a short-list of contaminants could greatly underestimate total estimated risk and the total benefits from risk reduction. The latter is favored by people who want to have cleanups justified by cost-benefit analysis. But using only indicator contaminants inevitably means *underestimating* total risk and total benefits (or total risk reduction) from cleanup.

A second major problem is that indicator chemicals are used for technology evaluation and implementation. But selection of indicator chemicals because of their documented health effects is not necessarily consistent with differences among site contaminants with regard to their chemical and physical properties which are critical to cleanup. Therefore, decisions regarding remedy selection, design of remedy, and—most critically—measurement of cleanup success may be seriously affected by the originally selected indicator chemicals. For example, it is quite conceivable that a cleanup could be judged to be successful on the basis of cleanup levels for indicator chemicals. But such a cleanup could leave a site contaminated with other contaminants which, in their own right, pose unacceptable levels of risk to health or-especially—environment, because environmental effects are not used on a par with health effects in the selection of indicator chemicals. Or site contaminants which are not indicator chemicals might seriously reduce the effectiveness of chosen cleanup technologies.

Benefits: More effective and consistent cleanups could be achieved, as well as fewer surprises arising in the later stages of the cleanup process that often mean increases in cleanup costs. Applying more public scrutiny as well as technical expertise early on in the selection of indicator chemicals could, in the longer term, make the entire cleanup process more efficient and effective.

Implementation: Either EPA or Congress could initiate a study which implemented this option. Such a study should be possible to complete in about 1 year by a university program with experience in chemistry, health effects, and environmental engineering. The study should include a detailed examination of sites within a few generic categories (e.g, wood preserving sites) to see if past practice has used consistent types of indicator chemicals. And the study should examine the performance of some recently completed cleanups to see the extent, if any, of problems arising because of the use of indicator chemicals.

OPTION 22: Clarify and Strengthen Cost-Effectiveness Requirement for Remedy Selection, Reject Use of Cost-Benefit Analysis

Major policy attention is necessary if we are to clarify what cost-effectiveness means, how the goal is achieved by the remedy selection process, and how it is different from cost-benefit analysis. This option embodies a policy commitment to cost-effectiveness as the way to meet national and site environmental objectives with limited resources. **The keystone of this commitment is using health and environmental criteria to decide on the extent of cleanup (risk reduction) first. Then, the lowest cost alternative able to reliably provide the selected level(s) of cleanup is selected.**[64]

This option requires a reexamination of the current framework for remedy selection, which uses nine criteria. One of these is cost—not cost-effectiveness. [65]The nine criteria have provided enormous flexibility to Superfund managers, enough to select virtually any kind of remedy and maintain that it is consistent with

[64]The method of setting cleanup objectives first and then determining the cost- effective remedy has been expressed by Congress ''The term 'cost-effective' means that in determining the appropriate level of cleanup the President first determines the appropriate level of environmental and health protection to be achieved and then selects a cost-effective means of achieving that goal. " Conference Report to accompany H.R. 2005, Superfund Amendments and Reauthorization Act of 1986, U.S. House of Representatives, 99th Congress, 2d session, Report No. 99-962, p. 245. In the debate on the conference report, Senator Mitchell said ''An analysis of cost effectiveness begins only after a remedial action has been selected m compliance with the health and environmental protection requirements, permanent treatment requirements, and other standards, requirements, criteri a or limitations imposed under the law. Congressional Record {daily cd,], 99th Cong., 2d sess., Oct. 3, 1986, at S14913.

[65]The other eight are: overall protection of human health and the environment; compliance with applicable or relevant and appropriate requirements of other statutes (' 'ARARS '); long-term effectiveness, reduction of toxicity, mobility or volume; short-tern effectiveness; implementability; State acceptance; and community acceptance.

statutory requirements and effective environmental protection. A recent study of Superfund concluded:

> **EPA has not clearly defined each** of the criteria nor how they are to be applied. , , . The Agency's current remedy-selection policy, in that it treats all the criteria equally, does not provide EPA staff, States, PRPs and concerned citizens with a framework that clarifies how tradeoffs are to be made among the different criteria in selecting a remedy.[66]

The current nine EPA criteria might be reduced to two essential steps ***after the*** precise cleanup objectives (based on existing environmental standards, risk assessment, and perhaps special cleanup standards) are determined: 1) analyzing each alternative for its ability to meet those cleanup objectives, and 2) estimating the full costs for each cleanup alternative (including **factors which are now in some of the nine** criteria, such as implementability and less than complete permanence). Then, with this option, the lowest cost alternative able to meet the cleanup objectives would be selected.

The goal of selecting a cost-effective remedy is **not the same** as cost minimization, which, in large measure, is the current practice. Nor does current practice define or use specific detailed cleanup objectives to examine cleanup alternatives and to justify the one selected.[67] When using cost-effectiveness, minimization of cost occurs after a remedy is selected, consistent with the cleanup objectives originally selected.

Superfund managers have a number of ways to minimize cleanup costs, starting with deciding as early as possible which are current risks and which are future, possible risks. Similarly, early recontrol and interim cleanup actions can reduce final cleanup costs because they prevent sites from becoming worse. Analysis of alternative technologies, including value engineering and full short- and long-term costs is also critical. More generally, costs will be minimized through: R&D and technology transfer; design optimization; pilot testing; new information about contamination or exposures which can reduce cleanup needs; competition among providers of cleanup services; and effective government procurement procedures and oversight of contractors.

Current Superfund practice has largely replaced the statutorily required cost-effectiveness approach with cost-benefit analysis. This option would explicitly reject the use of site cost-benefit analysis to justify cleanup, to set the extent of cleanup, or to select a remedy; it would prevent the changing of cleanup objectives with little public scrutiny. **As an** example of a conclusion based on cost-benefit analysis, a recent ROD said: ''The selected remedy provides overall effectiveness commensurate to its costs such that it represents a reasonable value for the money."[68] EPA's proposed National Contingency Plan has similar language, which would make current practice official policy.

The chief attribute of cost-benefit analysis, and its apparent attraction, is to consider environmental protection goals as variable. The chief presumption of the approach is the ability to accurately quantify both costs and benefits, even though experience demonstrates the inability to do either. Indeed, research shows that cleanup costs have more impact on remedy selection than any other factor, even though costs are nearly always underestimated at every stage of Superfund before cleanup is actually completed. Cleanup happens or stops when costs seem appropriate relative to estimated

---

[66] Clean Sites Inc., *Making Superfund Work*, January 1989.

[67] The Oak Ridge National Laboratory study mentioned above found that only 12 percent of cleanup decisions were based on a quantitative analysis of the degree of risk reduction provided by different cleanup alternatives. Even though some form of cleanup goals were also identified, the study noted that "few sites incorporated the cleanup goals into the evaluation of alternatives. "

[68] EPA Region III, Record of Decision, Ambler Asbestos Piles site, Ambler, PA., Sept. 30.1988.

benefits. A recent analysis disclosed that changing the current statutory structure for Superfund (i.e., risk-based decisions, for the most part, followed by cost-effectiveness analysis) to the cost-benefit approach would exacerbate current problems. According to the analysis, replacing the statutory approach with cost-benefit decisionmaking would, on the negative side, reduce risk reduction and equity from high to low, public accountability from high to very low, and administrative simplicity from high to low. On the positive side, the change would increase efficiency from low to very high.[69]

Some inevitable consequences of the cost-benefit approach include the following examples:

1. not cleaning up identically contaminated sites because at one, in a rural area, there are relatively few people potentially affected and other short- or long-term environmental benefits are ignored;
2. not cleaning up a site at all because there are no quantifiable current benefits and future benefits are discounted;
3. not using available cleanup technology which offers a truly permanent remedy because it is more expensive than another one, which is based on containment of toxic waste and not its destruction;
4. cleaning up only part of a site, which accounts for most of the **risk to health,** which can be quantified, but not the part which might pose some uncertain risk to environment;
5. stopping cleanup, even though original cleanup standards have not been met, because the marginal cleanup costs are high relative to the incremental benefits obtained, leaving, contamination in groundwater or soil above the cleanup standards;
6. having very different levels of cleanup among sites for specific contaminants in soil or water.

Benefits: This is a way to reduce excessive flexibility in remedy selection and, therefore, ensure that environmental protection is not compromised in order to minimize spending by the government or responsible parties. It is also a way to ensure that all approaches to reduce the cost of a cleanup with specified environmental objectives are examined and used where appropriate. Current flexibility is reduced in order to comply with statute and to obtain national consistency. By stressing proper use of cost-effectiveness, program managers would also be required to formulate specific environmental, risk reduction cleanup goals, something that is not now commonly done.

Implementation: This option requires congressional reaffirmation of the cost-effectiveness approach to Superfund management. Explicit statutory language would give the meaning and use of cost-effectiveness as well as the preclusion of implicit or explicit cost-benefit analysis. This would likely be opposed by those valuing maximum flexibility. Support would likely come from community and public interest groups.

Lastly, the statute has provided EPA a way to reject some fund-financed cleanup alternatives simply because their costs are too high. The fund-balancing provision is based on the legitimate environmental position that a very expensive fund-financed cleanup could consume so much money that the action would preempt a substantial number of other fund-financed cleanups. However, EPA has rarely used this statutory provision to reject cleanup alternatives with relatively high costs. If Congress provided more guidance on what level of spending could trigger use of this provision, it would make it possible for EPA to move outside of the cost-effectiveness approach discussed here *in exceptional* fund-financed cleanups. However, there is now no statutory basis for rejecting high cost responsible party-financed cleanups obtained

[69] Lester B. Lave and Eric H. Males, "At Risk: The Framework for Regulating Toxic Substances," *Env.* Sri. & *Tech.*, vol. 23, No. 4, 1989.

directly through a settlement (i.e., not subsequent to a fund-financed cleanup followed by a cost recovery action).

OPTION 23: **Better Integrate Community Perspective Into Enforcement and Site Decisions**

It was the perceived lack of public confidence in Superfund implementation which motivated Congress to enact the Technical Assistance Grants program in 1986. (OTA suggested this option in its 1985 report *Super-rid Strategy.)* Since 1986, implementation of the TAG program has been slow and interpretation of statutory provisions has resulted in complex, burdensome procedures and requirements for community groups. This option would provide major policy direction for the TAG program and its integration into Superfund implementation. Another trend since 1986 has been the expanded role of responsible parties in Superfund implementation, mainly because EPA has emphasized the settlement route to enforcement. Therefore, an emerging issue is whether EPA has balanced its enforcement of the polluter pays principle with concerns about victim's rights. (Victim may be a strong word, but it is important to acknowledge that community members are at risk; they perceive themselves as actual or potential victims, either because of health or economic effects.)

The presumption of this option is that victim's rights have become overshadowed by the desire by EPA to shift cleanup spending from Superfund to responsible parties primarily through voluntary or negotiated settlements. With this option, better balance between the two concerns would be sought. For example, EPA could be required to:

1. include community representation during its settlement negotiations and provide opportunity to comment on consent decrees and other formal instruments implementing settlements or carrying out enforcement actions for anything other than payment;
2. solicit formal community comments about key cleanup decisions;
3. provide more than perfunctory responses to community comments in its RODS;
4. instruct site managers to maintain ongoing communication with community groups during the entire time a site is within the Superfund program; and
5. require responsible parties implementing cleanups to maintain ongoing communication with community groups and to notify them of any new information which reveals changes in perceived site problems and problems in the performance of the selected remedy.

Benefits: This option would help balance the role of communities and responsible parties. If the emphasis on enforcement continues, this option becomes more important in improving public confidence in Superfund.

Implementation: Congress would provide statutory direction to EPA. A major implementation concern would be whether this option would result in delays in key cleanup decisions and actions. It seems that the best way of minimizing this problem is for government site managers to inform communities that their actions may have negative impacts. After all, it is not in the community's self-interest to cause unnecessary delays. But delays in the pursuit of improved environmental protection are justifiable. A site manager who concluded that community activity was causing a loss in environmental protection has an obligation to tell the community that and to take action to mitigate that impact. Another concern would probably be that the option would interfere with enforcement objectives. But enforcement should take second place to environmental protection and to the public's confidence in the government's sincerity and ability to provide that protection. The increase in program administrative costs to implement this option are uncertain. Congressional

oversight could give special attention to the effectiveness of this option and make changes if necessary.

Developing Workers and Technologies

OPTION 24: Make Site Managers Responsible for Sites From the Front-End of the Program Through Final Disposition

One person would have operational management responsibility for a site from the time it enters the Superfund system until the time it leaves it. The Superfund site manager option would apply the concept of project management in engineering or a case worker in social services. Indeed, the site manager has many engineering responsibilities and, moreover, critical responsibilities for dealing with affected communities, local officials, and responsible parties. The latter would look to the site manager as the person providing environmental services on behalf of the government. The site manager would have total responsibility for seeing that the site is handled efficiently, fairly, and consistently under law and EPA policies, and compared to other sites in the program. The site manager would draw on a broad array of experts to support his or her efforts, including experts in the areas of: technology, contracts, conflict resolution, policy, law, and health.

Benefits: Cleaning up sites is a complex process whose management could be made **more efficient by having one person responsible from beginning to end. Many human endeavors fall into the project management category and historically everyone has acknowledged the virtue of having a single point** of management responsibility to provide continuity over time. Accountability is improved by having a single overview of diverse activities carried out by many different people, including contractors and government staff. A site manager could be key in preventing unnecessary, redundant site efforts which now occur as different site activities are handled in different bureaucratic stages.

Implementation: This is a management option for EPA, but Congress could, through oversight or legislation, support or not support this approach. An obvious concern about this option is that EPA is currently having major problems retaining remedial project managers. Some people may believe that this option is infeasible because of this problem. But one of the ways to improve the status, importance, and pay for these key front-line people is to expand their role. Superfund site managers would become an elite corp of professionals; they would have the most comprehensive knowledge of the entire program, from one end to the other. People working in other parts of the program would aspire to become site managers. Having assistant site managers could provide on-the-job training under experienced EPA staff, as well as support for the site managers. The workload of site managers would be balanced by providing new site responsibility, for a site entering the system, as other sites near the end of the Superfund process.

OPTION 25: Establish Program for Certified Public Environmental Auditors

This option would require EPA to establish a new program to certify people who could attest to the quality of site and cleanup data and reports (i.e., for onsite investigation and engineering activities outside of analysis and studies which require no onsite activity). Responsible party studies and cleanups would have to use certified public environmental auditors. **Government agencies and groups receiving EPA Technical Assistance Grants would also be required to use certified public environmental auditors to the extent that the work was conducted by non-governmental contractors for onsite investigation and engineering activities.** The basis for certification would be meeting a set of criteria established by EPA after discussions with a number of organizations representing professional engineers, consulting engineers, hazardous waste professionals, and

EPA's Science Advisory Board. Such criteria would pertain to minimum cleanup experience, level of science or engineering education, and professional certification. EPA would make lists of certified individuals available to the public.

Benefits: Certification of experts would aid government oversight. This approach would improve the quality of contractor work, which seems critically needed because of the explosive growth of the industry and the rapid entry of many new companies. It would also help build public trust in contractor work for responsible parties.

Implementation: Congress could direct EPA to establish a certification program expeditiously. Certification could be implemented effectively through a concerted effort by EPA with the help of other groups in perhaps 1 year. Comments and ideas should be solicited from about a dozen engineering, professional, and trade organizations. Out of this activity would come a set of criteria and procedures for certification. Within EPA, certification could be managed by the procurement and contracts management office. Recertification could be every 5 years. To offset the cost to the government of administering this option, certification and recertification would require a fee, which would be paid into the trust fund in the same way that the primary fees are.

OPTION 26: **Strengthen Effort to Offset Current Limitations of the Government and Contractor Workforce**

The rapid expansion of Superfund created the conditions for workforce problems. It is axiomatic that the more inexperienced the workforce, the greater the need for strong management. In the case of Superfund, the situation was exacerbated by the enormous amount of money spent on contractors, resulting in a steady loss of government workers, keeping the government workforce inexperienced. And the growth of spending on contractors (from Superfund and other cleanup programs) has forced companies to hire more and more inexperienced people, despite siphoning away government workers. If Superfund implementation is to improve for the long term, then the government must give high priority to identifying weaknesses in the workforce and ways to offset them. With this option, EPA would have a permanent activity within its Superfund office to improve the performance of the national cleanup workforce. For example, continuing education and training, intensive technical assistance, improved administrative support, expanded use of electronic support (e.g., databases, expert systems), and more opportunity to attend technical conferences. Moreover, EPA could establish special programs with contractors, State programs, universities, research laboratories, other Federal agencies, professional and trade associations, and responsible parties to meet the objectives of this option. A special position would be established under the director of the Superfund office to carry out these responsibilities.

Benefits: For long-term success, the Superfund program must provide assurance to the public that the government is doing everything possible to make the cleanup workforce first rate.

Implementation: EPA could implement this option, but congressional support for increased spending seems necessary. Annual spending for this effort might be in the $5 million to $10 million range, which is small compared to cleanup costs.

OPTION 27: Establish a Bureau of Mines Superfund Support Program

Many Superfund sites are contaminated with toxic metals, such as lead, arsenic, and chromium. Achieving a permanent remedy for such contamination means recovering and using the metal. The Bureau of Mines is the Federal Government's major source of expertise appro-

priate to accomplishing this goal. The Bureau has already performed some important work at a few sites for some regional offices, but the Superfund program has not fully optimized its use of the Bureau.[70] This option would require a long-term commitment of funds to support the Bureau's continuing involvement, particularly for developing techniques applicable to generic categories with many sites, such as lead battery sites. Moreover, some sites have a combination of organic and metal contamination, and there is an opportunity to integrate metal recovery techniques into a series of cleanup steps for contaminated soils to achieve a permanent remedy. The Bureaus Superfund support program would include R&D, site treatability and feasibility studies, site demonstrations, technical assistance to site program managers and others implementing cleanups, and possibly managing some cleanups instead of contractors.

Benefits: This would be an efficient way to greatly improve the technologies used to clean up hundreds of current and future NPL sites contaminated with toxic metals. Very little recovery of metal site contaminants is currently used to achieve permanent remedies. The government has already invested millions of dollars over many years in creating the Bureau of Mines and its technical expertise is undisputed. The Bureau also is well positioned to network with experts in the academic and industrial communities. Developing techniques to clean up sites might also provide an opportunity to develop new mining techniques. The kind of expertise the Bureau has does not exist within EPA or the technical environmental consulting community now providing major support for Superfund implementation.

lmplementation: Although EPA could implement this option, congressional action seems appropriate to establish a significant program, probably at the level of $10 million to $20 million annually initially. This is particularly important if EPA is to move beyond the current limited use of the Bureau by its regional offices toward a national program with some long-term certainty to facilitate internal development of resources by the Bureau. One concern may be that pursuit of the recovery approach for metal cleanup will be expensive compared to current approaches. First, current approaches usually consist of: 1) offsite land disposal which is not a permanent remedy; or 2) onsite containment (i.e., capping of a site) which is not a permanent remedy; or 3) chemical fixation or stabilization treatment technologies whose permanence over very long times is uncertain. Moreover, the limited work to date with recovery and recycling does not suggest exorbitant cleanup costs. To the contrary, because there are large numbers of relatively similar metal-contaminated sites, it is likely that generic cleanup techniques can be developed and applied at many sites, bringing cleanup costs down. Moreover, the sale of recovered metal could reduce cleanup costs. The recently completed cleanup of the Jibboom Junkyard Superfund site in Sacramento, California ended up costing about $400 per ton to excavate and ship lead-contaminated soil to a landfill in Utah. But a decision to use a recovery technology developed by the Bureau for a permanent remedy at the United Lead Superfund site in Ohio involves a cost of about half that land disposal rate.

OPTION 28: Establish a Superfund Support Program at the U.S. Geological Survey

The USGS is one of the most respected technical Federal agencies; it has extraordinary information and expertise about groundwater. But to date the Superfund program has made relatively little use of USGS. With this option, a formal and stronger supportive role of USGS

[70]This seems to be but one example of a general strategic choice exercised early in Superfund's history; that is, it was decided to emphasize private sector contractors for Superfund implementation and not immediately available and potential resources of Federal agencies, The one exception is the Army's Corps of Engineers at the back-end of Superfund.

for Superfimd implementation would be created. For example, USGS could:

- assist R&D efforts to identify and develop effective groundwater cleanup technology;
- provide assistance in evaluating technical information provided by responsible parties concerning groundwater problems and cleanup;
- conduct parts of or all site investigation and feasibility efforts at sites where groundwater is the major problem, or review contractor studies;
- provide independent evaluation of the performance of groundwater containment and cleanup efforts at Superfund sites; and
- perhaps manage the cleanup of some particularly complex groundwater contamination.

Benefits; This option would improve the environmental performance of Superfund by using an existing Federal resource. It also compensates for the shortage of highly experienced technical personnel in EPA and contracting fins.

Implementation: **There** is no significant obstacle to implementation. EPA, however, has not used USGS effectively, and, therefore, congressional direction to do so may be advisable. This option seems feasible and valuable because for the past several years USGS has significant y and successful y carried out technical support for the U.S. **Air** Force's site cleanup program. Moreover, it is OTA's understanding that EPA's Inspector General's office has used USGS in the past to review Superfund studies and actions. Currently, USGS is working on site investigations and feasibility studies for about 20 to 25 Air Force sites, at an annual spending level of about $10 million. This is the type of Superfund activity currently performed by contractors. The level of activity envisioned for this option is annual spending of perhaps $20 million initially. USGS was able to develop its **Air** Force effort within its existing resources and staff; it is not clear how quickly it could commit to implementing this option. But USGS has some competitive advantage, relative to EPA, in attracting first rate technical specialists. Moreover, in its Air Force work, USGS has successfully expanded its capabilities through the use of certain types of contractors (e.g., site drilling and laboratory analysis) and, most interestingly, by using the experienced staff of some other Federal agencies such as the Bureau of Reclamation. There is also probably substantial opportunity for USGS effort in the R&D area.

OPTION 29: Increase R&D Spending, With Focus on Groundwater Cleanup

A long-term national cleanup program requires a stronger R&D program to develop more effective and lower cost cleanup technologies for the most prevalent and difficult cleanup problems. This option would frost consist of an independent study, for example by the National Research Council or EPA's Science Advisory Board. The basic objective is to define the exact targets for increased R&D spending within and outside EPA. **A** national research agenda is critical for avoiding unproductive and redundant research efforts. For example, improved groundwater cleanup technology is a critical need, as is permanent cleanup of large landfills through some type of treatment technology, but without large-scale excavation. Major attention to **the** potential use of in situ biological cleanup of groundwater seems critical. Even without a study, a major increase in the outstanding groundwater program at EPA's Robert S. Kerr Environmental Research Laboratory seems critically needed. There are also needs outside of cleanup technology; for example, more and better non-intrusive and non-invasive site investigation technologies to determine hot spots of underground contamination. Moreover, if cleanup in America is a permanent effort, then much more support of *basic* research is critically necessary.

Benefits: To the extent that there is a need for a wider range of technologies to effectively run

along-term cleanup program and to find innovative ways to reduce costs, a stronger commitment to R&D stands on its own merits. Moreover, a strong R&D program which inevitably means more university activity helps address the long-term need for greater education to improve the national workforce.

Implementation: This option requires action by Congress and support by EPA and OMB. Considering the enormous future spending on the national cleanup effort, a major increase in cleanup R&D spending is in a special class. The key issue is determining how much money to spend on R&D. It seems useful and appropriate to see annual R&D spending relative to total government and private sector cleanup spending. The latter is probably in the range of $2 billion to $4 billion currently by all parties. **Spending say 5 percent on R&D suggests a target of $200 million annually; this seems necessary because the national cleanup effort is still in its infancy, and because there is a critical need to reduce costs and come up with new, effective solutions. This figure is probably about three times larger than current public spending on R&D related to cleanup of chemically contaminated sites.** In particular, a several-fold increase in annual spending for EPA's Robert S. Kerr laboratory and for the Superfund Basic Research and Training Grants Program of the National Institute of Environmental Health Services would probably yield an enormous payoff in the years ahead. Together, current annual spending on these two programs is less than what is often spent on a single major site cleanup. Another important target for increased funding is the University Hazardous Substance Research Centers established by Congress in 1986.

Improving Government Management

OPTION 30: Combine Preliminary Assessment, Site Inspection, HRS Scoring, and Remedial Investigation Phases Into Single Site Evaluation Program

Three technical activities now make up the preremedial part of the Superfund program: preliminary assessment, site inspection, and HRS scoring. The Remedial Investigation is now part of the remedial program. This option would combine all four EPA staff activities into one organizational unit at the headquarters and regional levels. The premise of this option is that understanding the hazards posed by a site is a continuing learning experience based on getting more and better information about a site over time. All four activities constitute site evaluation. Use of the four current individual activities could be retained with this option, but they would be parts of a unified process and a single bureaucratic operation.

Benefits: Improved program efficiency and probably improved environmental performance would result from this organizational streamlining. Currently separate, often redundant activities would be combined in a simpler operation. Bureaucratic disconnects would be eliminated. Moreover, the front-end of Superfund would, through this consolidation, become more visible and important. Currently, relatively junior people perform the earliest, but, in a critical sense, the efforts with the largest long-term impacts. More senior and experienced technical people would be more likely to be attracted to these activities because of the greater scope of responsibility.

This option is particularly important in overcoming the currently popular view that cleaning up sites is a straightforward engineering job. In fact, however, the ' 'specifications' for cleanup are not fixed quantities, easily determined at one particular time. As complexity of contamination (e.g., types, amounts, and distribution) and natural site conditions (e.g., geology, hydrology, soil parameters, etc.) increases, site evaluation increasingly takes on the character of an evolving investigation instead of a one-time event producing correct answers. With complex sites, new information leads to new probes about the site and its problems. Moreover, as site

complexity increases, more discrete types of actions are taken at the site (e.g., emergency, removal, interim or operable unit actions, groundwater cleanup, soil cleanup, final remedial cleanup) and when these are implemented new information often arises which leads to unforeseen needs for new and different site investigation.

Finally, separating site investigation from current feasibility study activity could offer benefits. The feasibility study is supposed to take information about the site and its problems and determine possible cleanup solutions. This **is a very** different technical activity than site investigation. In fact, site investigation is fundamentally a *scientific* endeavor, seeking knowledge to define the problem (i.e., the cleanup specifications)-the demand side of cleanup. A feasibility study in conjunction with cleanup actions themselves, is fundamentally an *engineering* operation, in which a solution to the problem is conceived, designed, and constructed-the supply side of cleanup in which **cost** is explicitly factored into remedy selection. By keeping the activities separate—but with effective, continuing communication between the two-the integrity **of the two** different functions could be better maintained. This is in contrast to the current situation, where sometimes the definition of the cleanup problem and cleanup goals are compromised to fit what engineers (working for the government or responsible parties) say is feasible, desirable, effective, or low cost. In other **words, by separating site investigation from the remediation function, environmental needs will drive engineering solutions instead of the other way around.**

Implementation: This is a management improvement that could be implemented by EPA. However, current separate bureaucratic activities and different contracts pose a serious implementation problem. Unification of separate activities is never easy. However, from a long-term perspective, the ultimate benefits of bringing together essentially the same technical activities may be worth overcoming bureaucratic obstacles in the near term. Congressional action might be necessary to overcome bureaucratic inertia.

OPTION 31: Combine Removal and Remedial Programs Into Single Site Cleanup Program

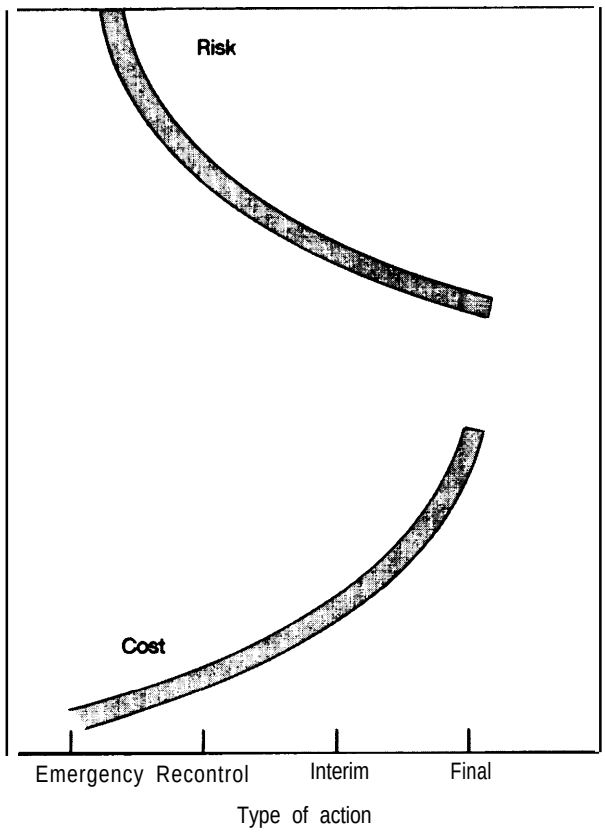
This option would recognize and institutionalize the relationship over time of different types of cleanup actions. The sharp distinction between emergency/removal actions and remedial actions would cease. Instead, Superfund management would recognize a continuum of cleanup actions over time: emergency, recontrol, interim (currently called operable unit), and final.

Total risk reduction decreases over time (see figure 1-2) as extent and cost of studies and actions increase over time. In other words, **in moving from emergency response to final remedy, the marginal costs on average increase, producing less environmental benefit per dollar over time. This progression of cost motivates aiming for initial cleanup actions at as many sites as possible, instead of aiming for final cleanups at relatively few sites.** Postponement of the final remedy (as with Option 1) is a way to optimize the entire Superfund system.

This option provides an explicit definition to each of these four types of cleanup action:

- Emergency response is self-evident: an immediate, urgent, and certain threat is addressed and is more important than procedure or policy preferences regarding analysis of the problem (Site Investigation) or selection and implementation of remedy. Emergency responses in this option would be essentially the same as emergency responses are now and applicable to non-NPL sites.
- Recontrol stresses preventing the spread of contamination into the environment aside

Figure I-2—Approximate **Reductions In Risk** and Cost **for Different Types of Cleanup Actions**



SOURCE: Office of Technology Assessment, 1989

from addressing risks.[71] Recontrol also means addressing near-term risks to health or environment because of current, certain exposures to hazardous material. Studies should be minimal for recontrol actions. Decontrolling a site may mean **actively maintaining** effectiveness through expedient engineering or institutional controls. That is, a service or continuing activity may be required to implement the action, such as monitoring, maintenance, and periodic repair. Recontrol measures usually: 1) impose physical or institutional barriers between the contamination and its environment, such as a cap on contaminated soil or buried waste, a slurry wall between buried waste and groundwater, above-ground storage of hazardous waste or contaminated soil, groundwater extraction wells which prevent a plume of contamination from spreading, fencing to prevent human exposure to contaminated soil, restrictions on use of contaminated groundwater, provision of new supply of water, relocation of **homes etc.; or 2)** use treatment technologies which leave residual contamination. With recontrol actions which leave hazardous material onsite, the need for a permanent remedy eventually is acknowledged. The proclivity to send hazardous waste to a landfill in the current removal program would be replaced by a policy to either store waste temporarily or send it to a treatment facility. Recontrol actions would be applicable to non-NPL sites, as with current removal actions.

- An interim remedial action achieves a partial remedy by addressing current risks to health or environment, leaving either future, uncertain risks to address or current risks for which no current technology offers a permanently effective remedy. That is, in contrast to recent.rol actions, there would be a preference for permanently effective technologies. Part of a site's problem may be addressed through an interim action, such as a soil or groundwater cleanup, or surface soil cleanup but

[71] Although there is some similarity between recontrol and removal (in the current program), this option could lead to a much larger use of recontrol. Removal actions do not stress recontrolling sites when spreading contamination does not pose immediate risks. For example, EPA said ''States generally are going to have to be responsible for non-time-critical removals where there is not an immediate danger but the site is deteriorating in a way such that something needs to be done over the next year or two." In general, EPA has acknowledged that its conduct of the removal program stresses limiting removal actions by defering actions to responsible parties and State or local government agencies, and non-NPL sites have the lowest priority. It is not clear that EPA provides significant oversight of actions taken by other parties. Limiting spending on the removal program has dictated the scope and number of actions. (Karen Burgan et al., "Setting Removal Program Priorities,'' *Superfund* '88, proceedings of November 1988 conference, Hazardous Materials Research Institute, Silver Spring, MD,)

not subsurface soil cleanup; several interim actions at a site may be necessary.

- A final remedial action would address all remaining current or future risks through technology which irreversibly renders hazardous site material nonhazardous. Delisting of a site from the NPL would only occur after completion and confirmation of a permanent final remedy.

Transfer of a site from Class I to Class II, as described in Option 1, could occur after emergency, recontrol or interim actions.

Organizationally, EPA would combine all cleanup activities into one unit, Site Cleanup, because all are fundamentally engineering solutions to a contamination problem, employing similar methods and technologies. Use of removal and operable unit terminology, which has not conveyed useful notions to the public, would cease. With this option EPA would formally be required to issue Records of Decision for every site cleanup action, except that an emergency action would not be held up for its ROD. For emergency actions a post-action ROD would be acceptable to establish a public record of what occurred. Currently, RODS are only issued for remedial actions, including operable units.

Benefits: This option would provide a technically rational framework for a range of complex site actions. Some current practices which seem to circumvent statutory requirements would be eliminated, such as performing remedial cleanups as removal actions. There has been confusion about the nature and purpose of removal actions. Neither public opinion or public policy supports removal in a literal sense, whereby toxic waste or contaminated material is removed from a site to a landfill, for example. The first choice is removal to a treatment or storage **facility,** although sometimes landfilling may be necessary. With this option, recontrol actions would be integrated into the full remediation of a site; currently, removal actions are not necessarily matched well with remedial actions.

Another benefit might be reduced studies, because recontrol and interim actions should not require extensive studies as are now being done for nearly all remedial actions and some larger removal actions. Public understanding of the true, complex nature of site cleanup would be improved and, hence, public confidence in the program could improve. The requirement that EPA issue RODS for every cleanup action would also improve public accountability and public confidence. Currently, there is virtually no accessible information to the general public or Congress which provides substantive information on what emergency or removal actions have consisted of, accomplished, or cost. All RODS should reference earlier RODS at the site in order to help people understand the history of site actions.

Implementation; This option requires statutory action. Definitions and limits for all four categories would replace current statutory distinctions for removals and remedial cleanups. An immediate issue is how current statutory provisions would apply to this framework. Therefore, there would have to be an explicit assignment of critical statutory requirements to the four types of actions. For example, current remedy selection and cleanup standards provisions, or modifications of them, might only apply to interim and permanent actions. Current spending constraints on removal actions could be applied to recontrol actions. Within EPA, there will be some resistance to this kind of conceptual and organizational change. Over time, competition has developed between the removal part of the program and the remedial part. Problems with existing contracting mechanisms would not be affected too much. Contractor services for emergency responses remain a unique kind of need. However, current distinctions between contract support for removal v. remedial actions would cease.

OPTION 32: Reexamine Current Statutorily Required Program Performance Schedules

Congress established a number of program performance schedules in 1986. However, in setting performance goals for the program, unintended impacts, such as eliminating or reducing environmental criteria for key decisions have occurred. EPA has said ''Achieving targets can mean trade-offs with achieving environmental results. Targets are numerical goals that do not measure quality, timeliness or risk reduction. ''[72] A recent study of Superfund said ''Time pressures sometimes reduce opportunities to involve all the affected parties (including the community) early in the remedy-selection process to promote consensus. ''[73] OTA agrees with these views. With this option, either the performance schedules would be dropped or they would be supplemented by explicitly directing EPA to assure that compliance was obtained without environmental compromises.

Benefits: Subtle but negative impacts on environmental performance would be eliminated by removing pressures on EPA to meet timetables which have little to do with effective cleanup. Mandated schedules direct EPA's attention away from satisfying requirements on cleanup objectives and remedy selection.

Implementation: Congressional action is required. This option requires rethinking the benefits of imposing performance schedules against the negative impacts they have on environmental performance. **EPA is facing almost a Catch-22 situation: either it compromises environmental goals to comply with schedules or it maintains environmental standards and fails to comply.** Either way, the agency draws public criticism. For the most part, EPA has done the former. But because of the complexity of the Superfund program, it has received relatively little criticism thus far for most of its environmental compromises, such as restricting the inflow of sites into Superfund. But such compromises are bound to have significant negative effects in the longer term.

OPTION 33: For Records of Decision, Require a Statement of Inconsistency for Selected Remedy

All RODS would be required to have a separate section for a statement of inconsistency, or a statement that none has been found necessary. This statement would force a routine consideration by site managers and their superiors of any significant inconsistencies between the cleanup action, particularly its cleanup standards and remedy selection, and statutory or EPA policy requirements, as well as with general practices (e.g., a deviance from a generally standard type of remedy selection for a generic type of site, or a postponement of a treatability study until after the ROD).[74] The inconsistencies would have to be identified and the **environmental** justification of them fully presented. Use of a new, innovative technology or a technology demonstration would be described and explained.

Benefit: This option would improve public accountability and, hence, public confidence in Superfund. It would reduce current inter-site and EPA regional inconsistencies. It would provide an incentive for effective use by Superfund staff of technical assistance resources and information transfer programs. EPA headquarters control of regional efforts would be enhanced. Congressional oversight would be improved.

---

[72]Environmental Protection Agency, *A Management Review of the Superfund Program,* June 1989, pp. 1-6.

[73]Clean Sites Inc. *Making Superfund Work,* January 1989.

[74]OTA has been told that such statements are sometimes a part of the administrative record or backup information to a ROD,

Implementation: Either EPA or Congress could implement this option. More effort would be required in ROD preparation by regional offices and another responsibility is placed on site managers, increasing administrative costs. But the cost seems marginally small both in an absolute sense and relative to potential benefits.

OPTION 34: Reduce Need for Formal Regulatory Compliance for Onsite Cleanups

In meeting the goals of simplification and speeding up cleanups it seems appropriate to eliminate regulatory requirements for permits—**not** health or environmental effects based standards-if their environmental objectives can be met more simply. The objective is to eliminate intensive time, labor, and paperwork requirements for regulatory compliance. On the assumption that a government agency wants to satisfy the functional requirements of environmental regulations, and that the need for expeditious cleanups has intrinsic environmental imperatives, elimination of formal, regulatory compliance is unlikely to jeopardize environmental goals. This option would go beyond the current statutory provision that eliminates formal compliance with Federal permitting requirements for onsite cleanups. With this option, all Federal, State, and local regulatory requirements for obtaining a license or permit to operate, or substantiating compliance with a regulatory requirement through documentation, would automatically be waived. The only requirement would be that EPA would have to publicly identify which requirements it was not planning to formally comply with and how it was achieving the same environmental objectives of the regulations. This would be done in a separate section of the Record of Decision.

Benefits: Cleanups would be speeded up and administrative costs reduced substantially.

Implementation: Congressional action is required. As a form of Federal preemption, this option poses certain traditional issues. However, many regulatory requirements would still pertain to Superfund cleanups, including, for example, all health or environmental effect based standards for acceptable levels of contamination in environmental media, regulatory definitions of hazardous wastes and substances, and regulatory bans against land disposal. Successful implementation without sacrificing environmental protection is contingent on the motives and capabilities of key Superfund staff, principally site managers. As long as only government personnel are entrusted with the power to bypass formal regulatory compliance, as compared to contractors or responsible parties, the risks of compromising environmental protection can be minimized. It might be useful, nevertheless, to also provide through statute the legal right of any governmental authority with regulatory powers or member of the public to petition the EPA Administrator within say 30 days after a ROD is issued for reconsideration because of some basis for believing that the intended noncompliance would likely lead to adverse environmental consequences (noncompliance because of emergency responses would not fall under this provision). OTA recognizes that some State agencies and regulations **have** been critical to achieving improved cleanups and this option is not meant to reduce the positive influence of stringent State programs.

OPTION 35: Establish a Formal Evaluation Program for Completed Site Cleanups and Long-Term Ones in Progress

There is a critical need for *independent* evaluation of the environmental and economic performance of Superfund actions. With this option, an ongoing performance evaluation effort would be established outside of EPA. Some sampling of sites in generic classes would yield critically needed information on how well technologies are performing in the field in an absolute sense and relative to estimates and projections made by the government or respon-

sible parties. It is important to discover the extent to which technologies are succeeding and failing, and the extent to which originally chosen cleanup objectives or requirements identified in RODS and consent decrees are being met or not met.

For example, for the Pepper's Steel & Alloys site in Florida, for which the responsible party was successful in gaining EPA approval for a first time, large-scale application of new technology, the cleanup has recently been completed. However, the responsible party, which now markets the cleanup technology, has requested EPA to do more than delist the site from the NPL because the remedy is successfully completed. It has also asked for ''unrestricted use of the affected property' and in its discussion of its implementation of groundwater monitoring has said:

> If [the presence of the constituent above the target level] is confirmed, then, if appropriate, an effort to determine the source of the constituent, or some other action consistent with the facts presented, might be **undertaken.**[75]

The latter is not a strong commitment for taking remedial action in the event that monitoring finds that the chemical fixation technology used at the site, contaminated in large part with PCBs, does not perform as expected. Indeed, the long term effectiveness of this technology for PCBs has been a major issue. The ROD had said:

> the action will require monitoring and institutional controls on future land use to ensure the continued effectiveness of the remedy. These activities will be considered part of the approved action.

Yet, immediately after the onsite treatment, the responsible party has reached a high level of certainty about the cleanup's effectiveness on the basis of laboratory testing and wants to remove the institutional controls on land use. Industrial use of the site, as desired, would also complicate interpretation of monitoring results with regard to responsibility for groundwater contamination.

With this option, if information was obtained which could immediately impact current decisions and program implementation, the program would issue some form of alert notice to EPA headquarters and regional offices, as well as other programs which are part of Superfund implementation (such as the efforts in Options 10, 11, 27, and 28). Otherwise, semiannual collections of site evaluations could be released to these groups and the general public.

Benefits: In a program as technically complex as Superfund and one in which there have been major problems with implementation, quality of work, and public confidence, there are benefits from having an *independent performance* review effort. Both the environmental performance and economic efficiency of Superfund would be improved, because there would be more use of the most effective technologies and less use of ineffective ones. Moreover, there would be improved information transfer through the system, improving the expertise and performance of the workforce. Public accountability would be improved. There is a particular need to build public confidence for less visible post-ROD activities, especially because of increasing implementation of remedies by responsible parties. There are also a lot of selected remedies which include institutional and engineering controls. This option would help in the implementation of the current statutory requirement for 5-year reviews when contamination remains onsite.

Implementation: Congressional action is necessary. This would be a new activity requiring additional funding. As envisioned here, the level of effort would be perhaps $5 million annually; that is, it seems feasible to examine about 25 to 50 sites annually, assuming a site evaluation cost of from $100,000 to $200,000. Although

[75]Florida Power & Light Co., *Final Report on Remedial Action—Pepper's Steel & AlJoys Superfund Site, Medley, Florida,* June 1989.

this effort would not have to be permanent, it seems useful to see it extending over the next 5 to 10 years. The most difficult implementation issue is the selection of the group to perform the independent analysis. Having a lot of experienced and expert professionals seems at odds with having true independence of the Superfund program, because nearly everyone associated with cleanup may have some involvement in Superfund. One possibility would be to create something like a Superfund Evaluation Board administered by the National Research Council; it could have a small core staff (such as recently retired, experienced government cleanup professionals) supplemented by consulting academics and others who would only examine sites for which they had no conflict of interest. Statutory direction to EPA to supply all requested information to the Board would be useful. It might also be beneficial, as with peer review of scientific journal articles, to maintain the anonymity of the professionals evaluating a site. The impact of cleanup reviews on Superfund implementation by EPA would be a priority of congressional oversight, if this option was adopted.

OPTION 36: Establish Formal Measures of the Program's Environmental Progress

Improving Superfund implementation for the long term requires developing meaningful measures of the program's environmental success. **With this option, the current practice of using bureaucratic outputs, such as numbers of studies and actions started and completed per quarter, number and dollar value of enforcement actions, numbers of different types of technologies used, and speed of passing through program stages would be replaced (or supplemented) by environmental outcomes.** There are two fundamental areas which, theoretically, could form the basis for formal measurements. First, some measure of how well professionals understand site contamination and conditions could be defined. Second, some measure of how much site cleanup has occurred **over** a given time could be derived; for example, whether current risks have been fully addressed, but not future risks (in terms of Option 1), and the extent of risk reduction or contaminant reduction. The goal in developing formal measures should be simplicity and a good analog is the use of technology performance standards, as, for example, the percentage of input hazardous material destroyed by an incinerator. For environmental performance at a site, therefore, we might want a comprehensive percentage to indicate how well the site is understood and a reduction percentage to indicate how much the site's contamination (or total risk) has been reduced. A special notation would indicate whether all current risks have been addressed permanently. Performance at the regional and national levels could be presented by some type of averaging of site performance figures over the appropriate population of sites.

Benefits: In the past, in other areas, approaches by EPA or others have been effective; for example, percent reductions in atmospheric or surface water pollution, or percent reductions in the amount of toxic chemicals in people's blood. If the American public can get a semiquantitative sense of the percent of the nation's contamination being destroyed, for example, its confidence in Superfund will be improved. Moreover, EPA itself needs to measure environmental results to assess its staff and regional offices.

Implementation: Congress could direct EPA to develop some formal measures of environmental performance. There are significant implementation problems. Designing specific factors to measure environmental progress is not easy. This is something that EPA's Science Advisory Board or a university might be able to help with over a 6-month period. Another problem is that the Superfund base is continually increasing, in terms of numbers of sites and information about sites moving through the system. One way to overcome this problem

might be to present figures only for individual sites. For program performance it might make sense to have an annual report which based performance on what was known to EPA at the beginning of the year; another way might be to base performance on a set of NPL sites. A detailed approach is beyond the scope of this OTA study, but the potential benefits justify serious attention to this basic need. Lastly, implementing this option will be made difficult by poor quality information on sites and by the frequent lack of specific cleanup standards.

OPTION 37: Address Conflicts of Interest Associated With Technology Selection

The selection of cleanup technologies in RODS is a primary determinant of future spending and, therefore, affects the economic interests of many responsible parties, cleanup companies, and technology developers. The chief potential problem is a selection of remedy which does not assure the best environmental results. Secondarily, decisions which are influenced by specific commercial interests interfere with market competition and can impede the introduction of newer technologies. For example, some of the major engineering firms working as Superfund or responsible party contractors own specific cleanup technologies. And a number of large corporations who are responsible parties at many Superfund sites have gone into the cleanup business, often by developing a particular new technology.[76] Therefore, there is a need for explicit attention to the potential for conflicts of interest which may affect critical cleanup decisions (see OTA's 1989 report on contractor use and a GAO report[77]). With this option, RODS would be required to have a statement that certified that all parties who have been involved in the execution of site studies or who have provided significant information on the site or its potential cleanup have been examined for conflicts of interest. A finding of no conflicts or of business interests which exist but which have not affected the site's decisions would be required.

Benefits: There would be more assurance that the best cleanup technologies for effective and minimal cost cleanups have been selected. Competition among cleanup technologies, particularly newer ones, would be safeguarded. The influence of responsible parties on remedy selection which compromise environmental protection would be reduced.

Implementation: EPA could implement this option. This option requires more staff activity, places another responsibility on site managers, and increases administrative costs. However, these additional requirements seem to be outweighed by the potential benefits. This option is likely to engender strong opposition from some firms and people.

OPTION 38: Reauthorize Superfund for 10 Years

Consistent with Superfund being a long-term program, the period of the second reauthorization would be increased from 5 to 10 years. This, of course, does not preempt congressional action, should the need arise, for changing statutory provisions.

Benefits: Considering both the past, difficult history of Superfund and the possibility, as envisioned in this report, of making fundamental as well as incremental changes in the program, providing stability and certainty appears highly desirable. This option would make program management and implementation by

[76]For example, the chemical fixation technology selected for the cleanup of the Pepper's Steel & Alloys site in Florida was one developed and now commercialize by the responsible party; EPA staff expressed some concerns about using the technology for cleanup of PCBs. For the cleanup of a number of PCB sites in Indiana, the government selected a novel but unproven type of incineration, which the responsible party could also develop commercially; there have been many objections to using this technology and cleanup has been delayed.

[77]GAO, *Superfund Contracts: EPA's Procedures for Preventing Conflicts of Interest Need Strengthening*, Feb. 17, 1989.

EPA easier, and it would also help everyone else, such as affected communities, public interest groups, responsible parties, and technology developers. It is significant that EPA has had great difficulty implementing SARA within 5 years; for example, there has been a substantial delay in finalizing the new National Contingency Plan to reflect statutory changes.

Implementation: Committees with legislative jurisdiction would have to act. Appropriations actions do not have to change.