SETTING PRIORITIES FOR ENVIRONMENTAL RESTORATION AT THE DOE NUCLEAR WEAPONS COMPLEX

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ABSTRACT

This paper provides an evaluation of the computerized methodologies and approaches that the Department of Energy (DOE) has developed to assist in setting cleanup priorities and in allocating Environmental Restoration funds to various activities within the DOE Nuclear Weapons Complex. Issues examined include the appropriateness of the methodologies for priority setting or budget planning, their strengths and weaknesses; the limitations to the use of such systems to aid decision making; public acceptance of these systems; and the level of participation by affected or interested parties and the public in the development and implementation processes.

INTRODUCTION; PRIORITY SETTING IN THE FIVE-YEAR PLAN

Recognizing the need for rational, defensible approaches to setting priorities for the expensive task of cleaning up the Nuclear Weapons Complex, DOE has been developing formal, computerized methodologies to aid the Department in managing its environmental mission. DOE has instituted a budgeting process and a stopgap methodology to set cleanup and compliance priorities, while embarking on a technological development path to enlist the aid of formal, computerized methodologies. Approaches being taken include environmental risk evaluation and ranking systems for setting cleanup priorities among the many contaminated sites, as well as budget planning methodologies to effectively estimate, request and allocate congressionally appropriated funds.

An important element in the 1989 DOE Five-Year Plan was the introduction of a tiered priority setting methodology to help guide DOE activities, support funding requests and administer DOE's budget for Environmental Restoration, Corrective Activities and Waste Management projects within the Nuclear Weapons Complex. DOE developed this tiered stopgap system by structurally grouping the compliance activities into four priority categories. DOE's stated goals for this priority system are: 1) to limit the immediate or short-term health risk and contamination; 2) to comply with in-place or pending agreements; 3) to reduce future risk, promote future compliance, address public concern, and protect Departmental missions; and 4) to accelerate overall compliance (1). A more sophisticated system to replace this stopgap system has since been developed and plans call for its introduction for use with future Environmental Restoration budgets.

The provisional priority scheme used for the 1989 and 1990 Five-Year Plans is a four-tiered system, consisting of the following categories, listed in order of descending importance (2):

Priority 1: includes all activities necessary to prevent near-term adverse impacts to workers, the public, or the environment. Also included in Priority 1 are ongoing activities which, if terminated could result in significant program and/or resource impacts.

Priority 2: encompasses those activities required to meet the terms of agreements (in place or in negotiation) between DOE and local, State, and Federal agencies. These agreements represent legal commitments to complete activities according to the schedules agreed upon by DOE.

Priority 3: includes activities required for compliance with external environmental regulations that were not captured by Priority 1 or 2. Other actions included in Priority 3 are compliance with DOE Orders.

Priority 4: includes activities that are not required by regulations but would be desirable to perform.

These priorities are applicable to activities within each of the Corrective Activities, Environmental Restoration, and Waste Management Operations program areas. Most current DOE environmental restoration and waste management activities actually fall into Priority 1 or 2 (3).

Important elements that impinge upon DOE priority setting are regulatory requirements for cleanup imposed by EPA and the states as well as interagency agreements that DOE enters into with these bodies. A valid priority system must be responsive to these realities.

DESCRIPTIONS OF COMPUTER-BASED SYSTEMS

Table I lists systems for setting priorities that use risk assessment methodologies that have been developed by federal agencies. The Remedial Action Priority System (RAPS) was developed for the DOE Office of Environment, Safety and Health (ES&H) by the Pacific Northwest Laboratory (PNL) to evaluate and rank the severity of contaminated sites. RAPS was designed to set priorities among inactive hazardous and radioactive mixed-waste disposal sites in a "scientific and objective manner" using limited information. Following development and testing, RAPS was renamed the Multimedia

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TABLE I

Computer-Based Priority-Setting Systems

Model	Type of Models Used	Agency[1]	Year	Public Comments[2]
HRS	Transport/Risk Assessment	EPA	1982	Yes
RAPS	Transport/Risk Assessment	DOE	1987	No
MEPAS	Transport/Risk Assessment	DOE	1987	No
DPM	Transport/Risk Assessment	DOD	1988	Yes

Notes: [1]Agency responsible for development.
[2]Were public comments solicited prior to use?

Environmental Pollutant Assessment System, or MEPAS, and is being used by DOE ES&H for evaluation of contaminated sites within the DOE complex. The results from the MEPAS evaluation of these sites have been incorporated into a DOE database known as the Risk Information System (RIS), which is being used in the DOE priority setting process (4).

The Environmental Protection Agency's Hazardous Ranking System (HRS), has been used since 1982 in conjunction with a site investigation process to screen and rank hazardous waste sites for placement on the Superfund National Priorities List (NPL). The Department of Defense's Defense Priority Model (DPM), has been used since 1988 to rank seriously contaminated defense installation sites for cleanup, utilizing information gathered from Remedial Investigation/Feasibility Studies (RI/FS). The HRS and DPM systems can be used in conjunction with another EPA developed system, the Cost of Remedial Action (CORA) (see Table II), to aid in the selection of remedial methods, estimate the costs of cleanup and assist the budget-planning process. The systems summarized in Tables I and II are described in some detail by Ton elsewhere (5).

Table II lists three systems developed for budget planning and cost allocation. The DOE was directed by the House Armed Services Committee in 1988 to develop a system to ensure the most efficient use of its allocated funds for remedial efforts. In response, the Office developed the Program Optimization System (POS). POS was designed as an aid to the DOE Environmental Restoration (ER) budget estimation and allocation process, using risk data and priorities from risk assessment systems. It was used to generate input to the FY 1990 ER budget request, based on Environmental Survey data evaluated by MEPAS. The final implementation of POS was delayed, and it has since been replaced by a somewhat similar system, the Priority System (PS). The PS shares its basic methodology, multiattribute utility analysis (MUA), and many features with POS, and was slated for formal introduction by the end of 1991.

EVALUATION OF DOE METHODOLOGIES

The DOE-developed systems must not only meet DOE technical objectives, but also assist the Department in reconciling its resources and capabilities with the requirements of environmental laws and statutes, and with the concerns of individual States, Indian tribes, interest groups, and local communities. Because the public will ultimately be affected by these decisions as well as provide the funds for the cleanup, a system that involves the public in its design and implementation and has public acceptance represents an essential element of cleanup efforts.

RAPS and MEPAS: RAPS and its successor, MEPAS, are extremely complex risk assessment methodologies; there are few current systems that have the combination of transport and exposure modeling capabilities that RAPS and MEPAS possess. RAPS and MEPAS' fundamental approach is a systematic one rather than the HRS' subjective scoring (checklist/questionnaire) approach used by EPA. In, general, the systematic modeling of contaminant transport and exposure using available and accurate site-specific data should yield a more direct, accurate estimation of risk, while the subjective scoring approach can only provide scores that are indicative of the risks present (6).

Like RAPS and MEPAS, the DPM also employs a comprehensive and systematic approach to transport and exposure modeling, and is used for the relative risk ranking of DoD cleanup sites. DPM is designed for use after the RI/FS study is completed, while RAPS and MEPAS were designed to bridge the gap between data available from the site investigation (SI) and from the full characterization required by the RI/FS process.

To compensate for the intensive data requirements of RAPS and MEPAS, PNL developed default values for field use of these systems, based upon assumptions about conditions and characteristics of the site, such as temperature and

TABLE II

Computer-Based Budget-Planning/Cost Systems

Model	Type	Agency[1]	Year	Use	Public Comments[2]
POS	MUA[3]	DOE	1988	Budget Allocation	No
CORA	Expert System	EPA	1988	Cost est./Planning	Yes
PS	MUA	DOE	1990	Budget Allocation	No

Note: [1]Agency responsible for development
[2]Were public comments solicited prior to use?
[3]Multiattribute Utility Analysis

rainfall (7). While the use of default values in the field eases the need for site-specific data, it does so at the cost of increased uncertainties in MEPAS results. Of the 138 sites surveyed and ranked by MEPAS during the 1987 - 1988 DOE ES&H Environmental Survey, only 34 were ranked using sufficient measured or collected data. The other sites were ranked using default values to supplement available data (8). While DOE stated that the default values were "conservative but realistic," using worst case scenarios for atmospheric and geologic data, the use of these values lowered the difference in risks across the ranked sites.

Reliance on default data instead of site-specific data also reduces the effectiveness of the RAPS and MEPAS' transport models. In one instance, officials from the State of Washington asserted that the MEPAS calculated values for some Hanford sites were far from actual survey data or results that were calculated using sampled data (9). DOE has stated that the use of default values has not strongly affected the MEPAS results, because relatively big differences in MEPAS input has not produced correspondingly large output changes during tests (10). However, to our knowledge, a full sensitivity analysis of the results has yet to be released by DOE.

The Natural Resources Defense Council evaluated MEPAS in testimony before the Senate Armed Services Committee. NRDC found that MEPAS: cannot distinguish between near and long-term risks; cannot identify the most exposed individual (MEI); uses an inappropriate combination of carcinogenic and non-carcinogenic effects; fails to consider multiple contaminants; is too data intensive; is too complex; sets priorities that might conflict with legal obligations; and has never been subjected to formal public comments (11). DOE has since responded to some of the NRDC technical charges but others, including policy issues, remain unchallenged. Of particular concern is the lack of opportunities for public review or comment of RAPS and MEPAS during their development and implementation. The results of MEPAS rankings from the preliminary Environmental Survey data were used to construct the RIS database, which also is not open to public review. By contrast, the EPA routinely publishes its findings and HRS ranking results in the Federal Register.

POS and PS: The manner in which the Priority System (PS) is being developed is somewhat of a departure for DOE. Unlike previous systems, external groups were invited to participate in different phases of PS development through workshops conducted by DOE. These groups include the State and Tribal Government Working Group, the External Review Group (ERG), and the Technical Review Group; the latter was a technical panel which met for two days in April of 1991 to evaluate the application of the system to the FY 1993 ER budget.

PS is designed to aid DOE in managing the budgeting for the cleanup of inactive waste sites at the Weapons Complex facilities, as well as remedial actions within the Defense, Nuclear Energy, and Energy Research Programs. It can be applied at different points in the budget process and can also be used to perform extensive cost-benefit analyses to determine the effectiveness of the distribution of funds. DOE can use PS to explore the implications of various funding levels allocated for each Operations Office by plotting and analyzing results obtained for benefits realized. In effect, DOE can use PS to locate the theoretical funding level where net cost equals net benefit, or where a dollar spent on remediation can theoretically yield a dollar of cleanup benefit. Thus, in theory, the systems can assure the most effective allocation of funding among the facilities (12).

Arriving at these highly detailed final selections, however, is based upon several significant assumptions. First, the analysis of different funding levels assumes there are no management, personnel, and technology limitations associated with increased funding, which DOE has stressed is not the case with its current infrastructure (13). Second, since the majority of the sites are yet to be fully characterized, current cost estimates for the cleanup must be based upon sparse data. It also follows that the benefit values used in the applications are very rough estimates, even more so than the estimated costs.

The POS and PS performance scale categories include health risks and regulatory compliance, two factors that are assumed to be independent of one another but may not be. Another inherent problem is that POS an PS seek to combine unequal benefits, such as reduction in health risks and regulatory compliance in their decisions, benefits that are very difficult to quantify. Other major omissions in the PS performance scales include lack of consideration of cleanup worker health risks and the lack of a performance scale to measure ecological benefit, or the cost of environmental damage.

Use of POS and PS Results in Decision Making: The use of multiattribute utility analysis (MUA) as the basis for the POS and PS systems represents a controversial DOE policy decision. In addition to the subjective selection of the various performance scales and weights, the data used in application of the systems are of variable quality and availability. An indication of the highly problematic MUA scales and weights is the fact that they have been changed with every application of the system. The fiscal year 1993 budget application of the PS weights was set using values determined by the Director of the DOE Office of Environmental Restoration. A technical peer review panel assembled by DOE to review this system found the weighting scales to be questionable, involving the overemphasis of individual risk, omission of worker risks, and unsuitable benefit measurement scales (9). The weights used in the PS system for the FY 1992 budget application were developed with little input from affected or interested parties, including the ERG, nor were they subjected to external review.

The inputs to POS and PS rely upon the prioritized and detailed activities data sheets (ADS) from the DOE Field Offices. For the 1990, 1992, and 1993 ER budget applications, site data used for ADS and the "activities prioritization" process came mostly from the DOE Risk Information System (RIS). The data contained in the RIS is the same Environmental Survey data processed through MEPAS, which is now three years old and does not cover all the sites under the ER budget. Since the system allocates funds to projects based on their ability to maximize cleanup resources, up-to-date and accurate site information is needed if the problems are to be addressed effectively and efficiently.

The incomplete risk data is problematic for several reasons. First, sensitivity analysis performed on the FY 1992 application of the PS found that changes as small as 0.01, or roughly 2.5% in the risk estimation can affect the system's selection and recommendations. There have been instances where the risk scores have been revised in "activities prioritization meetings," or during Phase III of the PS application due

to differences in field officer judgments (9). Second, without consistent and accurate site data, activities prioritization or cost estimation is uncertain at best because over reliance on default values has reduced the relative site risk differences. This is especially problematic with the new activities screening process used with the FY 1993 application of the PS in which "emergency activities" and "time- critical activities" do not require further evaluation in the priority setting process. Third, cost estimation is based on the proposed activities, which in turn are evaluated according to their abilities to reduce risks. Thus, the uncertainties are compounded as the information propagates through the priority setting and benefit evaluation processes.

Public Involvement in POS and PS: To date, DOE efforts to include the public in the development of the current PS have been somewhat limited. The FY 1992 application of the PS took place in the Spring of 1990, after only one workshop involving the External Review Group, without the input or knowledge of federal and state regulators, or the ERG. The ERG was dismissed by DOE in February of 1991, and the FY 1993 ER budget application of the PS took place in March of 1991, again without external input by State or Federal regulators, nor representatives of affected or interested parties. On September 6, 1991, the Department of Energy filed a request for public review of and comment on a "Preliminary Design Report: A Priority System for Environmental Restoration in the Federal Register" (14). The PS, as currently revised is being employed by DOE in the FY 1993 budget process. Comments by the Natural Resources Defense Council and the Environmental Defense Fund on the PS were filed on November 21, 1991 (15); in general these groups rejected the PS both on technical and policy grounds and proposed an alternative system for near- term use.

OPTIONS FOR IMPROVING THE PRIORITY-SETTING PROCESS

Retaining the Present Systems: If DOE chooses to work with the present systems, the first and foremost task would be to make its systems acceptable to the public, interested and affected parties, as well as to improve the systems to help reduce the uncertainty in decision-making. These objectives might possibly be achieved through involvement of the public in the modifications of the systems. In this modification stage, the Department needs to treat technology development and public involvement as an interrelated process. Possibly useful steps include:

- clearly defining the roles of RAPS and MEPAS;
- developing an open, public process for arriving at an accepted method of data gathering, site characterization, and a cohesive strategy for the use of this data;
- involving site-specific citizen advisory boards, as proposed by OTA (16), in many aspects;
- consulting experts and public representatives for input into the determination of PS scales and weights and making related information available to the public;
- implementing concrete provisions for public involvement in the setting of priorities and determining appropriate remedial actions.

Alternative Approaches: The Department could look into the adoption of methodologies available elsewhere. A simple screening of all current sites, as is possible with EPA's HRS methodology, could identify most of the sites that require further characterization, as well as create the framework for a complete database. Adoption of the HRS methodology would cause the DOE priority setting process to be compatible with the EPA, thus enabling DOE to draw on EPA experiences in identifying sites for further investigations, satisfying current regulatory requirements, as well as reducing the need for a complex system and extensive data needs. The Cost of Remedial Action system is another EPA system with potential to assist DOE in its efforts.

Another possible strategy is to improve upon the four-tiered priority system in the Five-Year Plan by expanding the number of categories. For example, Priority 1 activities can be further divided in to the three categories (emergency, time-critical, and other) developed for the screening of sites prior to recent application of the PS. Other criteria can also be used to evaluate Priority 1 activities; these include legal agreements, such as the inter-agency agreement deadlines; or by using site-specific health priorities developed in conjunction with citizen advisory boards (17) or other agreed upon standards. This approach has the advantage of simplicity, as well as ability to set cleanup priorities in a worst-first manner.

NRDC and EDF have proposed an alternative system for near-term use based upon answering three questions for each site: 1) are there ongoing or imminent exposures?; 2) is the contamination spreading?; 3) is an effective permanent remedial technology available? (15).

CONCLUDING REMARKS

The systems discussed in this paper use a variety of sophisticated techniques, including contaminant transport models and multiattribute utility analysis but they suffer from some inherent weaknesses as decision-making tools. One of these stems from the great complexity of the systems and the situations that they are called upon to represent. This complexity is in marked contrast to the unsatisfactory state of the quality, consistency and availability of the data that are needed to feed the systems, as well as uncertainties in estimating health risks. From a technical point of view, it is important that there be an independent assessment of both DOE computer-based systems and those developed by other agencies to see how well they mirror reality.

The nature of DOE's computer-based systems makes it very difficult to design an effective way of allowing for public participation in decisions that require significant non-technical as well as technical judgments. Perhaps if the DOE viewed these systems as aids to illuminate and keep track of the problems rather than as tools to make decisions, the gap that exists between the Department and its critics might be narrowed.

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