Peer Review of the FY 1998 Budget Formulation Process of the U. S. Department of Energy Office of Environmental Management

by the

Peer Review Committee of the Consortium for Risk Evaluation with Stakeholder Participation (CRESP)

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I. EXECUTIVE SUMMARY

A. Introduction

At the request of the Department of Energy (DOE) Office of Environmental Management (EM), the Peer Review Committee of the Consortium for Risk Evaluation with Stakeholder Participation (CRESP) reviewed the process employed by EM to prioritize its environmental management activities for FY 1998. The evaluation was carried out as the third part of a three-tiered peer review of EM's priority-setting process, instituted in response to recommendations from DOE's Environmental Management Advisory Board (EMAB).

In the Tier-3 evaluation reported herein, the Committee was asked to review EM's entire priority-setting process, including those aspects which had been dealt with previously in the Tier-1 and Tier-2 reviews. To assist in the evaluation, the Committee formed a subcommittee which included additional members chosen for their recognized expertise in relevant scientific and technical disciplines.

During the months of May to July, 1996, members of the Committee and Subcommittee met repeatedly, reviewed pertinent documents and reports, attended Tier-2 peer review and EM budget meetings as observers, and interviewed DOE headquarters and field office personnel, contractor personnel, stakeholders, and others. In the course of its review, the Committee also learned that Assistant Secretary Alm plans to modify EM's budget development process significantly by introducing a 10-year vision and related principles. Although the Committee has been able to examine the 10-year plan only briefly, we included in this report some comments to assist in the new approach, in addition to the findings and recommendations resulting from our review of the FY 1998 budget formulation process.

In performing the review, the Peer Review Committee was led to many suggestions as to how the process might be improved. In the following, these are discussed in detail. In some cases the suggestions could be implemented without much effort and would, therefore, be appropriate for the FY 1998 cycle. In others, the suggestions would require substantial reworking of the system, which might be inconsistent with the new approach being taken by EM or might be such that they should be considered for the FY 1999 cycle. Finally, some suggestions are focused on how one could develop a more complete system over several years, if desired.

B. General Findings

The Management Evaluation Process (MEP) used by EM in formulating its budget for FY 1998 represents a significant and creditable step forward in the evolution of an integrated approach for: 1) characterizing the risks to public health, worker safety, and the environment in the DOE Nuclear Weapons Complex; 2) linking such risks to compliance, fiscal, and other considerations; 3) involving stakeholder in the planning of mitigation efforts and future land use options; and 4) providing a multi-tiered peer review of the budget formulation process. Because risk should be a primary focus for EM in formulating its budget, and because risk management and risk assessment are important tools to be used in establishing an effective prioritization system within its decision-making process, the MEP represents a significant improvement over previous practice.

Among the strengths of the MEP is its provision for explicitly documenting and evaluating each of the following in prioritizing environmental management activities at a given site: 1) risks to the health and safety of off-site populations that may be associated with, or impacted by, the activities in question; 2) risks to the health and safety of site personnel; 3) potential impacts on the environment; 4) compliance with regulatory requirements; 5) impact on EM's mission; 6) cost-effectiveness, including " mortgage reduction;" and 7) potential social, cultural, and economic impacts. By addressing each of these considerations explicitly in the MEP, EM has endeavored to increase the transparency of its priority-setting process, to facilitate the ranking of activities in the field, promote cross-site consistency, and to involve stakeholders in the process. At a minimum, the process implemented in formulating EM's FY 1998 budget increased the use of risk as a decision factor, helped managers to make explicit to their peers and to stakeholders their rationale for the ranking of activities, and promoted cross-site communication.

In recognition of the fact that it cannot succeed without stakeholder support, EM has developed increasingly effective relationships with states, Tribes, regulators, and other stakeholders at most of its facilities. Stakeholders have appreciated the opportunity to be involved and have found their understanding of the choices facing EM and of the rationale for setting priorities to have been increased as a result. At the same time, many stakeholders have found it difficult to participate in the ranking of risks and in the formulation of the 1998 budget because of the demands of the compressed budget schedule, EM's lack of clarity in the process, and the complexity of the issues being addressed.

C. Lessons Learned

In evaluating the MEP, the Committee had the opportunity to assess its strengths and limitations in the overall context of risk ranking for the EM program and in relationship to EM's newly announced initiative to achieve concrete mortgage reduction steps over the

coming decade. It is in this broad context that we offer the following summary of the lessons learned from our review, in the hope that it may be useful to EM program managers and to others as they strive to establish priorities for allocating limited resources.

1. Linking Risk to the Budget

By introducing risk explicitly into its program planning and budget formulation, EM has significantly facilitated stakeholder consideration of the relative importance of different environmental management activities. As noted by the Environmental Management Advisory Board (EMAB) and the National Academy of Sciences-National Research Council (NAS), however, EM's risk approach is not without problems: notably, a lack of consistency in analyses among sites and inadequacy of the data on which risk analyses have been based. Nevertheless, EM's introduction of risk analysis into the process is well justified by the resulting potential for the improvements in stakeholder understanding and in decision-making.

Although EM is still at a relatively early stage in learning how to use risk analysis as a tool in budget formulation, it has taken a major step forward and should continue the process. Hence, in spite of certain limitations in EM's approach, the Committee strongly endorses its actions and has offered a number of suggestions for improving the system in the future. Above and beyond specific improvements that are suggested, the Committee strongly recommends that:

a. Risk analysis can vary in complexity but is a critical tool for use in sorting priorities and explaining decisions; hence it should be retained in the budget process as an important analytical approach to use in deciding and justifying what actions to support in EM's new 10-year focus;

b. Although risk is an essential factor, it is not the only factor EM should consider in planning and priority-setting; i.e., risk considerations are important when planning and siting remedial actions, but extensive, formal risk analyses are not needed for essential, ongoing, site-wide activities, such as monitoring effluents from stored wastes, providing and monitoring safe working conditions for workers, or completing essential R & D work;

c. Extensive, formal risk analyses, because of the substantial cost and time they entail, need to be used only where they can help to discriminate among options, and to be updated only when indicated by the availability of significant new information;

d. Headquarters should coordinate the process of risk analysis, so that:

1) sites use consistent definitions and analytic methods; and
2) cross-site comparisons can be made in a transparent and defensible manner;

e. Stakeholder involvement in the process should continue to be fostered, since stakeholder participation and external peer review are essential to ensure that difficult decisions are made in open forum and that public support is maintained; and

f. Many elements in the existing system can contribute effectively to, and should therefore continue to be used in, any process that may evolve in the future.

2. A Strategy for Improving the Linkage of Risk to the Budget

In spite of the noteworthy strengths of the MEP, the mechanism it has used for linking risk to the budget -- the Activity Data Sheet (ADS) -- has an inherent limitation which has hampered effective risk evaluation; i.e., the ADS's describe *activities* that are ready to be implemented, and thus they describe how work is to be done, not alternative ways of accomplishing the work. Furthermore, the activities that are needed to accomplish a given programmatic objective are often described in several (or even many) ADS's. Alternatively, an ADS may include a number of different objectives across a site. For purposes of ranking risk and exploring alternate ways of reducing risk, it is the importance and the relative riskiness of different ways of accomplishing the objective that should be scored, rather than the individual activities themselves. By often making Risk Data Sheets (RDS's) subordinate to ADS's and thereby, focusing risk evaluation on activities rather than objectives, the MEP has tended to obscure the relative importance of the primary purposes in question and to preclude consideration of alternative solutions. Furthermore, because the MEP has been largely activity-oriented, rather than objective-oriented, it has tended to evaluate the effectiveness of a given activity over too short a time horizon (i.e., a single budget year), rather than over the lifetime of the project in question.

To address this limitation, each discrete set of projects at a given site should be related to a specific geographical location. If the projects were to be defined in this way, the ADS's and RDS's for each project could be grouped accordingly and the "value" of each project characterized with respect to the scoring criteria in the Management Evaluation Matrix (MEM), thus facilitating the coupling of projects to the budget and to overall goals. Furthermore, if objective-oriented projects were to be prioritized (as opposed to management activities), projects that fell near the margin of the planning level at a given site could more easily be identified as those not to be implemented because of budgetary limitations, and all projects at all sites that were

at the budget margin could be more easily collected and intercompared in terms of their relative values and value/cost ratios. In some instances, quantitative assessments of the magnitudes and distributions of public, worker and environmental costs and benefits might be needed in order to support such intercomparisons, but such assessments would probably be feasible for the limited number of projects in question.

Many of the existing RDS's can readily be sorted according to project in the manner suggested. Some RDS's which support multiple projects may not be easily accommodated with this strategy, but ways to resolve the problem can be expected to materialize if the suggested approach is tested and allowed to evolve.

3. Risk Management Strategy

In order to accomplish its mission successfully, EM must utilize its increasingly limited resources most effectively and efficiently; i.e., it must develop a process that maximizes risk reduction, or benefit per unit cost (effectiveness/cost ratio) and minimizes landlord costs (mortgage reduction). Different strategies are required for high-risk projects, low-risk projects, and intermediate-risk projects.

For "high-risk" situations, the projects should be divided into two subgroups: one for situations in which the hazards can be stabilized through interim management, and the other for situations in which the barriers to exposure are expected to deteriorate, causing the costs and risks to increase within a decade in the absence of remediation. It is the latter group, because of its instability, that deserves first priority for risk management in the high-risk category.

For projects in the low-risk category, a cost management strategy is called for; i.e., in situations where the landlord costs are higher than remediation costs, the projects should receive a high priority, so as to maximize mortgage reduction, even if the risks are low.

Situations that are ranked intermediate in risk call for a "rolling stewardship," which relies on hazard stabilization and surveillance, with an observation period of up to eight years, for example, to allow development of transition options for the next decade. In such cases, monitoring should involve consideration of new technologies, dynamics of waste characterization, social perceptions, and maintenance costs. If and when updated analysis shifts the ranking out of the intermediate category, one of the aforementioned strategies should be implemented, as may be appropriate.

4. Central Guidance and Control

More centralized guidance for risk-scoring exercises is needed at the headquarters level, but the effort cannot be undertaken without substantial input from technical staff and stakeholders at the individual sites. Any system that is established should incorporate national-level goals, avoid parochialism, and, ideally, involve a single group of "reviewers." Periodic external peer review of the methodology is also recommended.

Priority-setting should also be staged incrementally over multiple years, so that adequate analysis of budget trade-offs and project alternatives can occur. It should include provision for periodic review of decisions, but not necessarily on an annual basis nor too tightly linked to the budget process. The frequency, extent, and cost of effort should be considered in light of the overall purpose and prospective concerns. Documentation of the process should be necessary and purposeful.

Last year EMAB recommended independent peer review of the budget formulation process, as reflected in this report. It is recommended that there be a similar independent peer review of the budget process for EM's new 10-year plan, whether the review is performed by CRESP or by some other group.

5. Defining and Measuring Permanent Reduction of Risk Profiles

Permanent reductions in risk are central to EM's mission and must be measured from some predefined level. The "min-safe" concept envisions maintaining a condition in which risk is limited to a socially acceptable level for a temporary "holding" period. Incremental changes in the permanent level of risk, positive or negative, may result from the impacts of unanticipated events (fire, failures of containment, etc.) or the impacts of remediation activities. It is the potential changes in the comparative levels of risk that should be considered in evaluating activities, or sets of activities, for budgetary allocations and over multiple budget years.

6. Consistency in Analyzing Risks

The databases, risk analysis procedures (hazard, exposure, transport, fate, etc.), assessment of the demographics of the region exposed, and assessment of impacts on human health and ecological units must be logically consistent across DOE facilities, so that interfacility trade-offs can be considered effectively. Site-specific characteristics involving proximity of human populations, endangered species habitats, nationally protected landscapes, and uniquely fragile ecosystems will influence the social perception of the value/cost relationship associated with risk reduction. Although it may be difficult to transfer monies between administrative units, the risk analysis procedure should be designed to facilitate consideration of this option.

Better coordination is needed between the on-site management and processing of wastes and their transportation to, and management at, long-term repositories. The distinction between the two is important since on-site maintenance and processing of wastes are site-specific activities, whereas the transport and long-term strategy of processed wastes must be handled on a more uniform and national basis.

7. Chemical Hazards

The risks associated with potentially toxic chemicals, synthetic organics, and heavy metals have not been, but should be, consistently given the same level of attention as has been given to the risks associated with radionuclides. This is important because the anticipated reassignment of land ownership for alternative societal utility must meet the regulatory requirements of certifying the site to be "clean"-- requirements which are usually incorporated into federal and state regulations and are often litigated in state, not federal, courts.

8. Developing a Framework for Ecological Risk Scenarios

The ecological scenarios associated with various existing or anticipated releases of toxicants to the regional environment, hitherto largely ignored, deserve more careful attention in the future. In such scenarios, moreover, it is the transport of toxicants through various media (air, surface water, groundwater, etc.) that determines the exposure of ecological units, the impacts of which depend on the time x space dimensionality of the exposures. As a result, the costs and benefits of any remedial activities that are called for can be expected to vary with the environmental media in question.

9. Nurturing Relationships with Stakeholders

Generally improving relationships may have increased the willingness of stakeholders to stay engaged in what can often seem to be a chaotic, ever-changing decision process. However, the relationships with stakeholders are fragile and still haunted by the legacy of secrecy and the distrust it engendered, and they are threatened by the perception that progress toward actual cleanup has been slow. Thus, EM must take care that its decision processes do not evolve on a strictly internal or budget-driven schedule which precludes the effective involvement of states, Tribes, regulators, and interested members of the public. EM must also guard against putting unnecessary burdens on stakeholders which might lead to their exhaustion, decreased effectiveness, and eventual disengagement from EM issues.

In spite of the effort that has been made to improve stakeholder involvement in EM activities, the level of involvement remains inconsistent across the Complex and less

than optimal at any site. Further progress could be facilitated by more careful and consistent planning, communication, and commitment at all levels of the organization.

EM's process for setting priorities and analyzing risk has been in flux for the last few budget cycles. This lack of stability in the decision process and the pace of the budget cycle have caused stress and inefficiency for stakeholders, as well as for field office personnel. EM policy makers need to introduce as much clarity and stability into the system as they are able, given their own changing tasks.

Toward that end, whatever system EM decides to use to set priorities and analyze risk in the future, managers need to make a more careful distinction between policy documents and instruction or guidance manuals. The 1998 guidance manuals contain lengthy explanations and justification of policy interspersed with specific guidance on how to carry out the policy. Indeed, in some instances, it seemed that policy was being made in guidance documents. Faced with tight schedules and long, densely written guidance documents (which were amended several times), people charged with filling out the forms may have simply turned to the Appendices describing how to complete a given task. Thus, they may have missed seeing important explanations of procedures, terms, and criteria, contributing to some of the unevenness in the RDS's.

10. Need for Different Kinds of Data Collection in the Future

Although the Committee recognizes that Risk Data Sheets may not continue to be used by EM in the same way, if at all, in future years, it recommends that EM continue to use risk evaluation in the budget process. In place of the existing Risk Data Sheets, however, which are not suitable for "one-size-fits-all" applications, EM may wish to develop risk analyses for situations in which the risks are relatively generic and probabilistic (where comparatively concise analyses may be appropriate) that are different from those used for situations in which the risks are more specific and require more detailed information (such as occupational situations involving risks of traumatic injury, acute and/or chronic chemical intoxication, and acute and/or chronic radiation injury).

The needs to be met in EM's 10-year plan can also be expected to call for changes in the process; i.e., to call for a process that would be better able to justify the selection of specific environmental management strategies for meeting targeted objectives at a given site and better able to measure incremental progress toward desired goals. In any case, to manage its activities more effectively and to respond more adequately to stakeholders, EM should develop an integrated, inclusive, reliable, and accessible

information system covering conditions throughout the DOE Complex, since, as pointed out by the National Review Panel (CRESP, 1996), the information in many RDS's is incomplete and/or lacks appropriate references. Although the missing information or references may exist in DOE or contractor documents, or in databases produced to support NEPA, CERCLA, BEMR or other decision processes, the information is difficult to locate or access, the databases exist in many forms (some of which are proprietary), and the quality of the data is uneven or unknown.

D. Conclusions

1. Given the nature of the environmental risks that exist across the Nuclear Weapons Complex, the secrecy that has shrouded them in the past, and the public concerns they have aroused, DOE's Office of Environmental Management (EM) is to be commended for seeking to address such risks explicitly and systematically in formulating its FY 1998 budget, and for attempting to involve all stakeholders in the process. Also praiseworthy in EM's FY 1998 budget process are its efforts to promote the cross-site consistency and cost-effectiveness of its activities and its implementation of peer review of the process. In each of these respects, EM has responded positively to recommendations from the National Academy of Sciences (NAS), the Environmental Management Advisory Board (EMAB), and the Defense Nuclear Facilities Safety Board (DNFSB).

2. In spite of the noteworthy improvements incorporated by EM in its budget formulation process for FY 1998, the process is an evolving one in which a number of problems remain to be resolved. Some of them result from deficiencies in the completeness, quality, and documentation of the information contained in the Risk Data Sheets (RDS's), and others are attributable to limitations in the data that are called for in the "Management Evaluation Matrix." Remedies for these deficiencies, some of which have been suggested in the Report of the National Review Panel, (CRESP, 1996), are recommended herein.

3. A more basic problem with the current process stems from its use of the Activity Data Sheet as the point of origin for the Risk Data Sheet. This practice tends to obscure the primary purpose of the environmental management activity in question, and it precludes the consideration of alternate solutions for the problem at hand. It has also led at times to the combining of management activities without appropriate justification. A preferable strategy would be to revise the scope of the Risk Data Sheet to match the particular problem or objective that is being addressed and to evaluate the effectiveness of the activity over a longer time horizon than a single budget year. Specific activities essential to achieving the objective would be listed in

the RDS.

4. Another fundamental problem concerns the way in which "minimum-safe" activities (e.g. security, fire protection, environmental surveillance) are treated. Such activities, which are an essential responsibility of site managers, were dealt with inconsistently in formulating the FY 1998 budget. It is recommended that in the future, essential, site-wide activities be placed outside of the RDS scoring process and included instead in the base program for each site, along with a multi-year plan for the site which reflects any projected task or mission changes.

5. Also of overarching importance is the need to strengthen the participation of stakeholders in the budget and priority-setting process. Although impressive strides have been made in achieving stakeholder involvement thus far, the level of such involvement has been inconsistent across the Complex and less than optimal at any site. To some extent, this is an inevitable result of the difficulties inherent in dealing with the complicated issues in question. Progress could be facilitated, however, by more careful and consistent planning, communication, and commitment at all levels of the organization and by all concerned.

6. Finally, it is concluded that further efforts to improve the effectiveness and transparency of the system should include the following: 1) refocusing the scoring process on cross-site comparisons of activities that are at the budget margin for any given site; 2) improving the definition of "minimum-safe" to distinguish between objective-specific and site-wide programs which should be separated from the scoring process; 3) more adequately considering chemical hazards, in addition to radiation hazards; 4) more adequately assessing potential impacts on the environ-ment; 5) more adequately considering the risks of health effects other than cancer; 6) more adequately considering future land use options; 7) more adequately considering potential transportation impacts; 8) exploring the need for, and feasibility of, quantitative risk assessments to support the scoring of risks to the health of workers and off-site populations; 9) examining the need for, and feasibility of, quantitative assessment of the benefit to society resulting from investment in the EM program; 10) performing a comparative analysis of various scoring and ranking models; 11) developing meaningful "environmental indicators" of EM progress; and 12) considering the value-to-cost ratio of a project as a key ranking criterion.

E. Recommendations

1. To strengthen its relationships with stakeholders, which will be essential to the successful completion of its mission, EM should address the need for more careful

and consistent planning, communication, and commitment to stakeholder involvement at all levels of the organization and by all concerned.

2. The systematic and explicit assessment of potential risks to site workers, off-site populations, and the environment -- which have contributed significantly to the effectiveness and transparency of EM's FY 1998 budget process -- should continue to be an essential part of EM's priority-setting process in the future.

3. To make its priority-setting process more effective and transparent in the future, EM should: 1) improve the quality, consistency, and documentation of the information and criteria it uses in the process; 2) replace its existing activity-oriented scoring system on cross-site comparisons of projects with an objective-oriented scoring system; 3) focus the scoring system on cross-site comparisons of projects that are at the budget margin within any given site; and 4) consider the ratio of project value to its multi-year cost as a key ranking criterion.

4. To improve the cross-site consistency and effectiveness of its priority-setting process, EM should: 1) give the process more central guidance and control in the future; 2) implement the process in incremental stages over a period of years; 3) increase the clarity and consistency with which "minimum-safe" and essential, s i t e - w i d e programs are defined across the Complex, and separate such site-wide programs from the process used for scoring other activities; and 4) subject the process periodically to outside peer review.

5. In order to utilize its limited resources most effectively, EM needs to apply a "rolling stewardship" strategy to the management of intermediate-risk situations; i.e., a strategy which relies on risk stabilization and surveillance, thus differing from the strategies appropriate for high-risk and low-risk situations.

6. In evaluating risks to workers, the public, and the environment, EM should: 1) more adequately consider chemical hazards, in addition to radiation hazards; 2) more adequately consider long-term effects, including effects other than cancer, in addition to short-term effects; and 3) explore the need for quantitative risk assessments, although such assessments, because of the substantial time and cost they entail, should be focused primarily on situations where they can best influence the decision process.

7. Other improvements in the priority-setting process that deserve to be considered include: 1) more adequate consideration of future land use options in project planning; 2) more realistic assumptions concerning possible restrictions on ground- water use in developing risk scenarios; 3) more adequate consideration of potential cost reductions from emerging technologies; and 4) more systematic consideration of the

potential impacts resulting from accidents in the transportation of wastes.

8. Apart from the improvements recommended above, the 10-year plan can be expected to call for other modifications of the process which have yet to be identified but which will need to be addressed in the near future.

9. EM should continue to implement independent peer review of its budget planning process.

II. BACKGROUND

The Department of Energy (DOE) Office of Environmental Management (EM) is responsible for managing significant quantities of radioactive and chemical wastes present in thousands of contaminated structures, land, and groundwater at some 120 sites across the Nuclear Weapons Complex. The tasks of characterizing, treating, and disposing of the wastes and of carrying out the measures necessary for remediation at the affected sites and facilities currently cost the nation approximately $6.0 billion annually (DOE, 95 b).

In the draft report Risks and the Risk Debate: Searching for a Common Ground, submitted to Congress in 1995, DOE identified as a primary objective the development of a process that would provide an integrated approach for evaluating the risks to human health, worker safety, and the environment in the Nuclear Weapons Complex and for linking such risks to compliance requirements and to the budget. Also, in a letter to the National Academy of Sciences dated September 13, 1993, Assistant Secretary Thomas Grumbly wrote: "... I intend to have the Department's major sites conduct a credible assessment of all the risks at the sites, with the active participation of all the local participants: state and local governments, local citizens, Indian Tribes, and other stakeholders. The overall process would be aimed at finding ways to identify and characterize the major risks, develop and use better technology and controls, and protect workers involved with the cleanup programs."

In pursuit of the above goals, and in an effort to clarify the relationship between funding levels and the ability to manage the risks in question, DOE's Office of Environmental Management (EM) has implemented a process for bringing together information collected at the various EM field locations on the scope, costs, risks, and other attributes of ongoing site activities, and for involving stakeholders in the process. Steps in this direction were helpful to EM in its FY 1997 Internal Review of Budget (IRB), and the "Management Evaluation Process" (See Appendix XI.B) used by EM in formulating its FY 1998 budget represents an attempt to build on the experience.

In the FY 1998 process, a standardized form -- the "Risk Data Sheet" (RDS) -- was used by managers in the field as a tool for prioritizing environmental management activities. An RDS was prepared for every major activity, based on one or more previously existing "Activity Data Sheets"(ADS's). The RDS (Appendix XI.C) described the activity in question, summarized its budget needs, and characterized any associated risks in terms of: 1) impacts on public health and safety; 2) effects on the health and safety of workers; 3) environmental impacts; 4) compliance with regulatory requirements; 5) mission impact; 6) "mortgage reduction" (i.e., cost-effectiveness); and 7) social, cultural, and economic considerations.

The information contained in the RDS's was ultimately used by each field office to rank its environmental management activities on the basis of each of the following criteria: 1) compliance with regulatory requirements; 2) mortgage reduction; 3) risk reduction; 4) responsiveness to stakeholders; and 5) overall priority, all things considered. The resulting five priority lists, along with the respective RDS's (which numbered more than 1400 across the entire Complex), provided input from each field office to EM's internal budget review (IRB) process for FY 1998.

To improve its environmental management process, DOE has implemented peer review of the FY 1998 process in a three-tiered approach, in keeping with the recommendations of its Environmental Management Advisory Board (EMAB, 1995).

In the first tier, the process was reviewed at each site by local personnel representing all program areas, according to guidance and training developed by a central group of experts, stakeholders, and regulators.

In the second tier, based on the guidance developed in Tier-1, and with efforts to ensure cross-site input, reduce bias, promote cross-site consistency, and enhance credibility in the process, an EM-wide review of the quality, completeness and consistency of the information in the Risk Data Sheets was conducted by a panel of risk assessment professionals, environmental experts, former DOE employees, field office representatives, and independent scientists, under the leadership of the Consortium for Risk Evaluation with Stakeholder Participation (CRESP).

In the third tier, the entire process was reviewed by CRESP's Peer Review Committee, a group of independent experts formed previously by CRESP to ensure the scientific quality of its studies and to maximize their credibility and acceptability to stakeholders.

III. PURPOSE

The purposes of the review reported herein were to:

A) Evaluate the effectiveness of EM's entire process for prioritizing its environmental management activities for the FY 1998 budget;

B) Evaluate the extent to which pertinent recommendations from DOE's Environmental Management Advisory Board (EMAB), the Defense Nuclear Facilities Safety Board (DNFSB), and the National Academy of Sciences (NAS) have been adopted and utilized by EM in prioritizing its environmental management activities;

C) Identify any shortcomings in the process used by EM to prioritize its environmental management activities, and recommend approaches for solving such problems or improving the process in other ways.

The results of the review are addressed primarily to the managers of the EM program, but the findings and recommendations reported herein are intended to be informative and helpful to others as well, including field personnel, members of Site-Specific Advisory Boards, persons residing near contaminated sites, regulators, and other stakeholders.

IV. REVIEW PROCESS

To carry out the evaluation reported herein, CRESP's Peer Review Committee formed a special Tier-3 Review Subcommittee to assist it in the undertaking. The members of the Committee and Subcommittee were chosen for their recognized expertise and for their ability to represent the necessary spectrum of relevant disciplines. To avoid conflicts of interest, persons who were, or had been, directly involved in any related activities were excluded from membership. The members of the Committee and the Subcommittee are listed in Appendix XI.A.

The Subcommittee held its first meeting on May 9-10, 1996, at which time it was welcomed by Dr. Bernard Goldstein (CRESP Principal Investigator) on behalf of CRESP. Dr. Charles Powers (CRESP Executive Director) then briefed the Subcommittee on its charge and acquainted it with pertinent background information. Dr. Carol Henry and Mr. Mark Gilbertson, of the EM Office of Science and Risk Policy, subsequently discussed DOE's budget formulation process and how the Subcommittee might respond to the Department's needs. An additional briefing was received from Dr. Jack Moore (CRESP Science Coordinator), who reported on the status of the Tier-2 Review of the RDS's by the National Review Panel. Following these presentations, the meeting focused on definition of the tasks to be accomplished and on the development of an effective action plan for accomplishing

them.

The Subcommittee held its second meeting on June 20, at which time it received further briefings from Drs. Jack Moore and Charles Powers, and reviewed discussion papers on various topics prepared by members during the interim. The latter included: 1) a report on EM's Internal Review of Budget (IRB) meeting, which had taken place in Washington, D.C. on May 20-24, with several Subcommittee members in attendance as invited observers; 2) reports on telephone interviews conducted by Subcommittee members with DOE headquarters personnel, field office personnel, contractors, and stakeholders; 3) a report on a "Lessons Learned" workshop conducted by DOE on June 18 in Denver, Colorado, at which a Subcommittee member attended as an invited observer; and 4) reports on various other topics pertinent to the tasks at hand.

The Subcommittee met for a third time on July 16 to assemble and discuss its draft report, and on July 17 it presented the report to the full CRESP Peer Review Committee. Pursuant to these meetings, the penultimate draft of the report was prepared and circulated for factual review and comment to the CRESP Management Board and to the DOE Office of Environmental Management. The final version of the report was submitted in early August, 1996.

V. FINDINGS AND CONCLUSIONS

In view of the nature of the environmental risks that exist across the Nuclear Weapons Complex, the secrecy that has shrouded them in the past, and the public concerns they have aroused, DOE's Office of Environmental Management is to be commended for seeking to address such risks explicitly and systematically in formulating its FY 1998 budget, for attempting to involve all stakeholders in the process, for its efforts to promote the cross-site consistency and cost-effectiveness of its activities, and for its implementation of peer review in the process. The major findings and conclusions emerging from our review of the process are summarized below, beginning with the effectiveness and strengths of the process.

V. A. Effectiveness and Strengths of EM's FY 1998 Budget Process

V. A.1. Documentation of Relevant Risk Factors

By including explicit entries for the relevant risk factors in the "Management Evaluation Matrix" (MEM) that was used to characterize environmental management activities on the RDS, EM's FY 1998 process represents a positive step toward the goal enunciated by

Assistant Secretary Thomas Grumbly (Grumbly, 1993); namely, that "the Department's major sites conduct a credible assessment of all the risks at the sites, with active participation of all the local participants: state and local governments, local citizens, Indian Tribes, and other stakeholders."

V.A.2. Consideration of Risks to Public, Workers, and Environment in Budget Process

A significant strength of EM's FY 1998 budget formulation process was its requirement that risks to the health of off-site populations, risks to the health of on-site workers, and risks to the environment each be addressed explicitly and separately in the MEM. This requirement was an important step forward in helping to ensure that these risks received the consideration that each deserved in prioritizing environmental management activities.

V.A.3. Consideration of Other Values (e.g., Social, Cultural, Economic Impacts, Mission Impacts, and Mortgage Reduction) in Budget Process

The inclusion of explicit entries in the MEM for these values, which also deserve to be considered in the budget process, has greatly enhanced the potential for completeness, transparency, and overall effectiveness of the process.

V.A.4. Facilitation of Rankings in the Field

By requiring that the different types of risks and other values to be considered in prioritizing environmental management activities each be documented according to standardized and defined criteria, the process has the potential for greatly facilitating the ranking of such activities by decision makers and stakeholders.

V.A.5. Facilitation of Stakeholder Involvement

Given the nature of the Department's activities, the secrecy in which many of them were characteristically shrouded in the past, and the public concerns they have aroused, the extent to which the FY 1998 process strove to involve stakeholders is noteworthy. Although the level of stakeholder involvement is still less than optimal in most instances, the progress that has been made to date is encouraging.

V. B. Overarching Issues and Areas for Potential Improvement

In spite of the noteworthy improvements incorporated by EM in its budget formulation process for FY 1998, the process is an evolving one in which a number of problems remain to be resolved. Some of them result from deficiencies in the completeness, quality, and

documentation of the information contained in the Risk Data Sheets (RDS's), and others are attributable to limitations in the data that are called for in the "Management Evaluation Matrix," as noted in the Report of the National Review Panel (CRESP, 1996). In addition, there are a number of overarching issues and more fundamental problems with the process, which are discussed in the paragraphs that follow.

V.B.1. Limitations Stemming from the Use of the ADS as a Starting Point for the RDS

a. Introduction

The MEP process is based on the premise that, in order to establish a linkage between the budget and risk, the starting point for establishing this linkage is the site operations' work breakdown structures (WBS) and the associated Activity Data Sheets (ADS's). The RDS guidance states:

"An ADS reporting element is defined as an executable unit of work consisting of common geographic and/or physical characteristics that can be described and analyzed as a discrete activity or group of activities. An RDS reporting element may be a subset of an ADS reporting element for which all encompassed activities have the same risk or hazard classification. ...with respect to the RDS's, it is recommended that each site create them to correspond to the highest level (least detailed) of its own work breakdown structure (WBS) to which it manages its work."

The use of the ADS's as the starting point for the MEP may, however, have imposed boundary conditions that limit the ability of the process to be fully effective in establishing a consistent and unambiguous relationship between budget and risk to the public.[1]

b. The Problem

One of the recurring themes that arose during the review of the RDS's and the discussions with site personnel was that the scope of the RDS is not always clearly defined, and that there are interrelationships between RDS's that may make it difficult to score any one particular RDS. The RDS guidance calls for at least one RDS for each ADS. However, ADS's are often elements, or are comprised of elements, in a work breakdown structure, and several ADS's, in combination, are designed to accomplish a specific objective. Hence, scoring these elements in separate RDS's could be misleading because the value of any individual activity, especially with respect to public safety, can be assessed only within the context of the full suite of activities that, together, are intended to accomplish a given objective. Consideration

[1] The definition of the RDS adopted by the MEP seems to be well suited for evaluating worker risks, but not necessarily public risks.

needs to be given to scoring the importance of accomplishing a given objective, and not necessarily scoring the means by which the objective is accomplished.

Inspection of the RDS's reveals that they support activities that, either individually or in combination with other activities, are designed to accomplish one or more of the overarching objectives listed below:

1. Public safety and health
2. Worker safety and health
3. Environmental protection
4. Compliance with Environmental Statutes and the associated State and Federal regulations, including Federal Facility Agreements
5. DNFSB recommendations
6. DOE-regulated activities under the Atomic Energy Act, as amended
7. Site Vision Statements
8. Mortgage reduction
9. Stakeholder requests
10. Protection of cultural resources
11. Administrative functions
12. Compliance with treaty requirements and trust obligations

Each ADS and RDS and its scope must be understood with respect to the degree to which the activity fulfills one or more of these needs. In addition, where appropriate, such as in the selection of a particular Environmental Remediation (ER) remedy, the rationale for selecting a particular activity, as opposed to selecting plausible alternative activities, must be understood and communicated. It is not always apparent from the ADS or the RDS as currently used why a given activity is needed and the degree to which alternative approaches for fulfilling a need were in fact considered.

In many cases, several RDS's (or parts of the scope of several RDS's) in combination are designed to accomplish a specific objective. In other cases, a single RDS, or part of the scope of a single RDS, supports multiple objectives. In both cases, the relationship between the budget delineated in the RDS being scored and public risk is obscure.

The extent and potential significance of these problems, and insight into strategies for their resolution, are best demonstrated by a review of a sample of RDS's. A review of the first 66 RDS's for the Savannah River Site (SRS) was performed for the purpose of defining a suite of objectives and the RDS's that support these objectives. The following table (Table V. B.1) presents the results of this review.

In developing this table, the Committee used its judgement regarding what constitutes a

discrete objective and then sorted the RDS's according to each objective. A total of 66 of the 270 SRS RDS's were reviewed, which resulted in the identification of 23 separate objectives. Other reviewers might create a somewhat different list of objectives; however, the intent of the table is to demonstrate that the RDS's are often so highly interdependent that assigning public risk scores to many of the RDS's individually has little meaning.

Inspection of the table reveals that scoring the objectives with respect to public safety, or, for that matter, any one of the other seven MEM categories, is often a more meaningful and doable exercise than attempting to score individual RDS's. For example, Objective 1 is concerned with maintaining the F and H Areas separations facilities in a safe stand-by condition for use in stabilizing spent fuel and nuclear materials. A total of six RDS's are identified which are concerned with achieving this objective. Clearly, providing this service is essential to DOE's mission, and a high score should be assigned to all seven MEM categories. The question then becomes, are the discrete activities that are associated with this objective needed in order to achieve this objective, and does scoring the individual RDS's add any value to the process? If the individual activities can be demonstrated to be needed to accomplish the objective, then their budget is justified, and the sum of the budgets for all the activities combined is appropriately linked to the seven MEM categories. Whether scoring the individual activities adds value is debatable. For example, scoring the activity that supports the acquisition of capital equipment (i.e., R96A0002), though critical to accomplishing the objective, does not provide a complete picture of the relationship between cost and the benefits associated with accomplishing the objective.

The table also reveals that several RDS's represent activities that are needed to support more than one objective. For example, R96A0030 provides general support to several waste-related objectives, including Objectives 7, 8, and 10. R96A0026 supports Objective 5, 6, and 10. RA96A0021 provides QA support for Objectives 7, 8, and 10. R96A0049, which provides certification support, supports Objectives 12, 13, 14, 16, 17, 18, and 20. Finally, RDS's R96A0022, 0023, 0053, and 0062 all provide broad-based support to the site as a whole and, therefore, support all objectives.

In many of the cases listed (Table V.B.1), there is a 1-to-1 correspondence between the objective and the RDS. Under these circumstances, the current approach to scoring the RDS's can work. In other cases, such as those listed in the footnote to the Table, the RDS's support site-wide activities that are needed to support all site activities and programs. In these cases, there is very little need to score these RDS's. However, there is a need to demonstrate that the activities and the associated budget are needed to support the myriad of planned activities and programs at the site.

c. An Alternative Strategy

One strategy for resolving this issue is to sort all activities according to the primary need or objective that the individual activities support. The objective or need is scored according to the MEM, and not necessarily the individual activities. In addition, the budget associated with each activity supporting a given need or objective is then summarized. In this way, the benefits and costs associated with accomplishing a given objective can be more clearly related to the budget.

Such an approach in relating budget to risk raises questions regarding the basis for the need or objective and the basis for the specific activities selected to accomplish the objective or fulfill the need. Each of the underlying objectives likely key back to one or more of the overarching objectives listed above.

In the case of objectives that are designed to satisfy the Resource Conservation and Recovery Act (RCRA), the Comprehensive Emergency Response, Compensation, and Liability Act (CERCLA), and other legal requirements (i.e., primarily Environmental Restoration (ER) activities), the process for selecting a given activity likely includes a formal assessment of alternative remedial strategies and corrective actions. These evaluations are often documented in Remedial Investigation/Feasibility Study (RI/FS) and RCRA Facility Assessment (RFA) reports and in Records of Decisions (ROD's). For other ER activities, the RCRA/CERCLA process may not have progressed very far, and the activities may need to be defined in very general terms and without the benefit of an assessment of alternatives. The status of the RCRA/CERCLA process can be described in the ADS, along with the degree to which alternative remedial strategies are being evaluated.

For Waste Management (WM) and Decontamination and Decommissioning (D&D) activities, there is often an Environmental Assessment (EA) or Environmental Impact Statement (EIS) required as part of the National Environmental Protection Act (NEPA) process. The selected WM and D&D activities are likely the outcome of a formal evaluation of alternatives, including the "no action" alternative. With regard to activities initiated as a result of DNFSB recommendations, such as those contained in Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-1 related to Nuclear Materials and Facility Stabilization (NMFS), the specific activities planned in response to DNFSB recommendations may go through either a National Environmental Protection Act (NEPA) review or a review by the Defense Nuclear Facilities Safety Board (DNFSB). Hence, each activity is likely to have a pedigree of sorts that may go back many years, and which should be disclosed and documented as part of the scoring process. As such, the MEM scoring process may be better applied to the prioritization of objectives, and, thereby indirectly establish the priority of their supporting activities. The implication is that evaluating risk at the scope of the RDS's may not be needed in these special cases.

Table V.B.1. Description of Program Objectives at the Savannah River Site and the RDS's that Support those Programs and Objectives.

Objectives	Supporting RDS's
1. Maintaining the F and H Areas separations facilities and supporting facilities in a safe, inventoried, warm stand-by condition for the purpose of stabilizing spent fuel and nuclear materials.	R96A0001 This RDS supports S&M and provides infrastructure support for the separations area. R96A0002 This RDS supports the acquisition of capital equipment needed to replace aging equipment required for S&M and infrastructure support for the separations area. R96A0003 This RDS supports the S&M activities for the F-Canyon. R96A0017 This RDS supports the continued safe operations of the ETF, which processes liquid waste from separations operations. R96A0005 This RDS supports the S&M activities for the H-Canyon. R96A0063 This RDS provides for upgrades in the safeguards and security systems for the F and H Areas.
2. Management and mitigation of the risks associated with the radionuclide inventory in the FB-Line.	R96A0004 This RDS supports the S&M activities for the FB Line. The FB Line converts Pu feed material from the F Canyon to Pu-239 metal, stabilizes processed residues to metal, and repackages other materials for long term storage in the FB-Line vaults or other storage facility.

Objectives	Supporting RDS's
3. Management and mitigation of the risks associated with the radionuclide inventory in the HB-Line.	R96A0006 This RDS supports the S&M activities for the HB Line, which serves a role similar to the role of the FB-Line but for the H Canyon.
4. Management and mitigation of the risks associated with the radionuclide inventory in the 235-F Secured Vault Facility and Process Area and supporting facilities.	R96A0007 This RDS supports the S&M activities for the 235-F Vault and associated facilities. This facility stores and protects processed special nuclear material.
5. Management and mitigation of the risks associated with the radionuclide inventory in the H and F Area tank Farm.	R96A0008 R96A0009 R96A0011 R96A0012 R96A0013 R96A0014 R96A0015 R96A0016 R96A0026 R96A0027 R96A0033 R96A0034 R96A0035 R96A0036 R96A0037 These RDS's support Tank Farm General Plant Projects (GPP); S&M of the H and F Area Tank Farm; upgrades to the tanks, the infrastructure, and supporting facilities (including the installation of additional evaporators that will increases the available HLW storage capacity, and retrofits); risk assessments in support of upgrades, and retrofits to the tank farms, associated feasibility studies and demonstration projects for the upgrades.
6. Maintain the continued safe operations of the Saltstone Facility for the processing and solidification of LLW	R94A0025 Supports solidification of LLW at the Saltstone Facility. R96A0026 Supports General Plant Projects, including the Saltstone facilities.

Objectives	Supporting RDS's
7. Maintaining the continued safe operations of the ITP/ESP (In Tank Precipitation and Extended Sludge Processing) facilities, used to separate and process waste for eventual disposal as low-level waste in the Saltstone facility and for processing high activity waste in the tank farm.	R96A0010 Provides for S&M for the ITP/ESP facilities. R96A0029 Evaluation of the risks associated with the ITP/ESP facilities. R96A0021 QA in support of S&M in support of waste management operations. R96A0017 This RDS supports the continued safe operations of the ETF, which processes liquid waste from separations operations and the tank area. R96A0028 Supports programs for providing feed to the ITP/ESP and vitrification program. R96A0030 General support for HLW projects, the ITP/ESP, the ETF. R96A0038 Evaluation of ITP/ESP upgrades.
8. Continued operations of the Effluent Treatment Facility (ETF).	R96A0017 This RDS supports the continued safe operations of the ETF, which processes liquid waste from separations operations and the tank area. The system is required to meet NPDES permit requirements. R96A0021 QA in support of S&M in support of waste management operations, including HLW and LLW management programs. R96A0030 General support for HLW projects, the ITP/ESP, the ETF.

Objectives	Supporting RDS's
9. Assessment and remediation of contaminated groundwater in the 10 square mile A/M Area.	R96A0018 Assessment and remediation of contaminated groundwater in the 10 square mile A/M Area.

Objectives	Supporting RDS's
10. Vitrification of HLW.	R96A0019 S&M in support of the HLW vitrification system for the waste in H- and F-Area Tanks if the vitrification program were suspended. R96A0020 S&M in support of the HLW vitrification program for the waste in H- and F-Area Tanks. R96A0017 This RDS supports the continued safe operations of the ETF, which processes liquid waste from many operations, including HLW treatment operations. R96A0021 QA in support of S&M in support of waste management operations, including HLW and LLW management programs. R94A0024 Supports vitrification R96A0028 Supports programs for providing feed to the ITP/ESP and vitrification program. R96A0032 Supports the Late Wash Facility required for pretreatment of the ITP precipitate before it is vitrified. R96A0030 General support for HLW projects, the ITP/ESP, the ETF. R96A0026 General support for vitrification, Late Wash, and Saltstone facilities

Objectives	Supporting RDS's
11. New vaults for storage of solidified HLW and HLW equipment.	R96A0031 New vaults for storage of solidified HLW and HLW equipment.
12. Management of approximately 28,000 55 gallon drums of TRU waste.	R96A0039 This RDS support the safe operations of the TRU waste facilities and TRU management activities. (This RDS may be too broad because it includes a very broad range of activities, such as exhumation of buried waste, venting and over packing drums, receipt and storage of TRU waste, waste storage, and S&M operations.) R96A0043 This RDS supports the base operations for the management and planning for solid waste management activities. R96A0049 This RDS supports activities related to compliance with waste certification requirements.
13. Management of approximately 1000 55 gallon drums of mixed waste.	R96A0040 This RDS supports the safe operations of the mixed waste management activities. (This RDS may be too broad because it includes a very broad range of activities, such as storage, treatment, and on-site and off-site disposal, S&M activities.) R96A0043 This RDS supports the base operations for the management and planning for solid waste management activities. R96A0049 This RDS supports activities related to compliance with waste certification requirements.

Objectives	Supporting RDS's
14. Compliance with FFCA and RCRA with respect to the treatment and disposal of mixed waste.	R96A0041 This RDS supports efforts specifically pertaining to compliance with FFCA and RCRA with respect to the treatment and disposal of mixed waste. R96A0043 This RDS supports the base operations for the management and planning for solid waste management activities. R96A0049 This RDS supports activities related to compliance with waste certification requirements.
15. Completion and operation of the Consolidated Incineration Facility (CIF).	R96A0042 This RDS supports the operation of the CIF. R96A0045 Supports base operations of LLW facilities. (This RDS may be too broad because it includes a very broad range of activities, such as storage, treatment (including CIF), and on-site and off-site disposal, S&M activities.)
16. Management of hazardous waste.	R96A0044 This RDS supports the base operations of the hazardous waste facilities. R96A0043 This RDS supports the base operations for the management and planning for solid waste management activities. R96A0049 This RDS supports activities related to compliance with waste certification requirements.

Objectives	Supporting RDS's
17. Management of about 25 tons per day of sanitary waste.	R96A0046 This RDS supports the base operations for the management and planning for sanitary waste management activities. R96A0049 This RDS supports activities related to compliance with waste certification requirements.
18. Management of annual receipt of about 500,000 cubic feet of LLW.	R96A0045 Supports base operations of LLW facilities. (This RDS may be too broad because it includes a very broad range of activities, such as storage, treatment, and on-site and off-site disposal, S&M activities.) R96A0043 This RDS supports the base operations for the management and planning for solid waste management activities. R96A0049 This RDS supports activities related to compliance with waste certification requirements.
19. Waste minimization and pollution prevention programs.	R96A0047 This RDS supports activities related to the minimization of waste production at the site. R96A0048 This RDS supports activities related to the minimization of waste production at the C Area.
20. Waste certification.	R96A0049 This RDS supports activities related to compliance with waste certification requirements.
21. Activities related to the remediation and closure of the Radioactive Burial Grounds.	R96A0064 This RDS supports activities related to the investigation, remediation, and closure of the Radioactive Burial Grounds.

Objectives	Supporting RDS's
22. Activities related to the remediation and closure of the old TNX Seepage Basin.	R96A0065 This RDS supports activities related to the remediation and closure of the old TNX Seepage Basin.
23. Activities related to the assessment and remediation of groundwater in the vicinity of the F- and H-Areas Seepage basins.	R96A0066 Activities related to the assessment and remediation of groundwater in the vicinity of the F and H Areas Seepage basins.

* There are certain categories of activities that support all programs at the site simultaneously, such as infrastructure programs and fire protection. RDS R96A0022, R96A0023, R96A0053, and R96A0062 support such programs.

V.B.2. Treatment of Minimum-Safe (Min-Safe) Activities

a. Problem

As noted by the National Review Panel (CRESP, 1996), minimum-safe activities consistently received higher risk scores in the FY 1998 budget formulation exercise than the relevant permanent remediation actions designed to correct the problems in question. Unfortunately, while essential in the near term, such min-safe activities are not the basic EM mission, and a scoring and ranking process producing the above result will likely fail to give adequate priority to the fundamental clean-up mission.

b. Background

The following example of the storage, treatment, and disposal of a particular waste illustrates the problems. The current process often segments the storage, treatment, and disposal steps, resulting in multiple RDS's. The RDS budget guidance called for assuming discontinuance of the activity but the maintenance of institutional controls when evaluating the "before" scenario. However, when the activity being evaluated was itself essentially an institutional control, e.g., min-safe storage, this created an ambiguity. In practice, for a min-safe storage activity, the "before" scenario evaluations often assumed discontinuance of funding and controls. Thus, for min-safe storage, the baseline for assessing risk reduction sometimes became the "walk-away" state which, therefore, produced a high-risk state. The "after" state assumes restoration of funding and controls at the same point in time, and the restoration of a "safe," generally low-risk, state. The RDS for treatment apparently takes its baseline as the "safe" storage condition and takes credit only for the additional risk reduction from that state to a "safer" state, such as waste immobilization. Likewise, the disposal RDS takes its baseline from the treated waste state and takes credit for the additional risk reduction from disposal.

The risk reduction differential for the treatment or disposal scenario is often less than for the storage scenario. In addition, the "before" and "after" points for the treatment and disposal RDS's are the times "before" and "after" project implementation, and thus, are different than the starting and ending points assumed for the storage RDS. If, in fact, the storage RDS had used a similar endpoint and consistently evaluated walk-away risk, its net risk reduction would be zero since the storage activity does not provide any permanent risk reduction.

The combination of segmented RDS scopes, shifting baselines against which risk reductions are being scored, and different "before" and "after" times creates a system in which the true EM objectives are not being reflected in scores and ranks.

In addition, minimum-safe activities were interpreted rather widely in some cases pertaining to a specific structure, and in others on a site-wide basis.

c. Recommendations

i. Consistent Risk Baseline

A stable and consistent baseline needs to be established against which risk reductions are scored that properly values permanent risk reduction. Additionally, "before" and "after" should be interpreted consistently. "Before" should mean the time at which the earliest essential action is begun. "After" means the time at which the last essential action is concluded (exclusive of long-term surveillance and monitoring).

Finally, unless significant new risk impact or cost information bearing on the specific program objective emerges, the high (H), medium (M), low (L) score of the specific program objective would not change in yearly budget reviews until the "after" time is reached. This is to avoid stoppage of activities prematurely based on changing baselines and lower risk scores, as progress is made.

ii. Reorient the Scope of the RDS

Following the discussion and recommendations in V.B.1 the scope of an RDS should be aggregated to the level of a specific program objective tied directly to completion of the EM mission. "Specific" is intended to tie the objective to a discrete waste or contamination problem, facility, or end product. In the above case the objective would be the treatment and disposal of the waste in question. All activities essential to the achievement of that objective should be listed (preferably in chronological order), and costed out for the duration of the time required to achieve the specific objective of the RDS.

Notwithstanding the above example, it should be noted that ultimate disposal is not the only endpoint appropriate to the EM mission. Waste immobilization, facility entombments and contaminated site remediations that require maintenance of institutional controls are other appropriate endpoints. Two conditions appear to be critical in determining endpoints; first, that the endpoint results in permanent reduction and second, that all parties (DOE and stakeholders) understand up-front what the endpoint will be.

Although the 10-year plan documentation is still evolving, it should be noted that there are strong similarities between the definitions and format envisioned above, and the 10-year plan guidance, to date. For example, the concept of "specific program objective" described above appears similar to the 10-year plan definition of "project" as a "defined set of related activities or functions that support a discrete end state or end product related to mission completion." In addition, the description of the specific program objective and its essential activities described above is similar to the project, milestone and cost information requested in the

Supporting Data Worksheet (Attachment IV of the 10-year plan documentation) for the 10-year plan. One difference may be the treatment of certain level of effort activities which appear to be given a distinct description in Attachment IV as opposed to subsuming such activities within the description of the appropriate specific program objective, as envisioned herein. Nevertheless, it may not be difficult to append an abbreviated "before" and "after" risk discussion (see section V.B. 4), and the risk scores, to Attachment IV, thereby, directly and visibly integrating the risk considerations into the 10-year plan supporting documentation.

iii. Tracking Progress by Objective

Progress should be tracked against the specific program objective defined in recommendation i. above, rather than by component activities. Meaningful indicators of such progress can be developed (see section V.B.7). By tracking in this manner, managers are required to allocate the funding provided for the overall objective to the component activities in a manner that maximizes permanent risk reduction.

V.B.3. Possible Restructuring of the Decision System

a. Purpose of Decision System

There are two purposes of the decision system. The first is to set priorities at each site among projects. The criteria are risk-reduction driven, but encompass other elements, including costs, which must be considered in order to achieve an optimized priority ranking. Obviously, costs are an important element in setting priorities because it is benefits per unit cost which determine the return to each potential expenditure. The second purpose is to allow redirection of resources from established patterns in order to more effectively use available funds to meet national objectives.

b. Requirements of Decision System

The first requirement is to facilitate within-site decisions to assure that base requirements are met and that discretionary funds go to the most "worthy" projects -- again based on risk reduction potential but moderated by other factors. In brief, the system should discriminate among potential projects that would be worth doing if resources were available, but are not urgent, and those which are exceedingly valuable or urgent and which would be done except under the most extreme budgetary constraint. The "not worth doing" and the "exceedingly valuable or urgent" projects are almost always obvious and require little if any analysis to identify. In contrast, the middle category requires extensive analysis to assure that resources are placed where their marginal benefit is greatest.

The second requirement of a decision system is that it facilitate the cross-site redeployment of resources. For this purpose, no information is required on either site-based projects or on "exceedingly valuable or urgent" projects; it is obvious that "not worth doing" projects are similarly of little interest. Further, in a steady-state budget atmosphere the redeployment between sites is unlikely to be greatly in excess of 20 percent. These considerations suggest that projects in the range of about 20 percent, plus or minus, the historic budget trend should be the focus of analysis, and that it is exceedingly important that this analysis be done well.

Both purposes of the decision system are best achieved if analysis is reduced on all projects other than those which are discretionary but appear worthy, and if it is expended on the latter. All actual decisions focus on these projects, and it makes sense to put resources into informing them to the extent reasonable.

c. Prioritization in the Revised Decision System

During the recent IRB meeting, Mr. Alm described the vision and operating principles for the EM budgeting process. The goal of the IRB is to establish a budget that will eliminate major risks and mortgages in ten years. One needs to assess priorities within the constraints of a ten-year planning period and a budget of about $6 billion per year. Therefore, one needs to develop a decision-making process that effectively and efficiently utilizes resources. This involves maximizing the risk reduction benefits per unit costs (effectiveness/cost ratio) and minimizing landlord costs (mortgage reduction). Strategically this involves three different strategies: one for high-risk/high-impact projects, one for low-risk projects, and one for intermediate-risk projects.

High-risk scenarios should be divided into two subgroups. One involves situations in which the hazard can be physically maintained, with stable barriers to exposure through system management. The other subgroup includes situations that are physically unmanageable, and in which the barriers to exposure will deteriorate in a decade, so that the associated costs and risks will increase. Risk management dictates that this second group should demand first priority within the "high-risk" set.

Examples of these situations are unconstrained expansions of contaminated groundwater plumes (uncontrolled) and well-maintained, double-walled tanks containing concentrated radionuclides. Both situations could deserve a high-risk ranking, but the uncontrolled situation would demand the most immediate attention.

The low-risk group, on the other hand, involves a cost management strategy. Projects where the landlord costs are higher than the remediation costs should receive a high priority so as to maximize mortgage reduction. This is true even if the risks are low. Examples of these include a situation where a relatively small amount of contaminated soil is discretely located

on a large federal facility. The landlord costs of security, monitoring, management, etc., is often very high relative to the costs of physically relocating the contaminated soils (high-priority cleanup). A situation where the sediments of a large reservoir were contaminated in the mid-50s and are now covered with clean sediments (low-risk) involves landlord costs (manage reservoir for sediment stability) that are low compared with remediation (dredge and disposal). In this latter case, cleanup would have a low priority.

Those activities ranked intermediate in risk or impact will require a "rolling stewardship," which relies on hazard stabilization and surveillance, with, for example, an eight-year observation period and a two-year reassessment period to allow transition options for the next decade. Monitoring will involve new technologies, dynamics of waste characterization, social perceptions, and maintenance costs (i.e., the aforementioned cost-management strategy may be applicable here as well). The reassessment will involve a full-fledged relative risk analysis. When the updated analysis transforms the ranking from the medium category, the previous strategies are then implemented: high-risks are evaluated as risk management, low-risks are addressed as cost management.

The time period is flexible. This presentation has used a ten-year example to correspond to Mr. Alm's proposed planning period. This "rolling stewardship" provides for a periodic reassessment of emerging technologies, budgetary realities, and new data for better risk assessments. The rankings can change either through changes in risk assessments (new risk assessments) or through new available technologies (mortgage reduction).

The "rolling stewardship" also provides a logical basis for initiating or postponing remediation activities. These decisions represent an integrated balance between science and economics. The transparency of the logic allows for stakeholder debate at the local level and peer review at the national level.

d. Advantages of the Alternative System

The limited number of analyses undertaken would serve to prioritize the site's proposed activities and would also be the basis for any redeployment of resources across the Complex. This would allow decision makers to focus on projects where their review could make a difference. It would also free up analytical talent to conduct more robust analyses of the projects actually examined. It would improve morale because effort would no longer be expended on projects where no change in decision was contemplated.

A further advantage is that by concentrating attention on a much smaller scope of actions, stakeholders will have time -- and incentive -- to become more deeply invested in the system. Finally, by taking some projects "off the table" and assuring that they either will -- or will not -- be done, certainty can be increased, planning can be confidently undertaken, and long-term

economies realized.

e. Potential Disadvantages of the Alternative System

The first disadvantage is that the system creates opportunities for gaming to increase the flow of resources to a site. This can be controlled but not eliminated by built-in reviews.

The second disadvantage is that it tends to reduce the budgetary cycle's oversight of performance for projects that fall below the budget cutoff point. This loss must be weighed against its marginal effectiveness now, especially given the other control measures in place.

The third disadvantage is that it reduces the ability of Headquarters to impose its views of the proper trade-offs between risk reduction and other criteria for projects and activities that fall below the budget cutoff point. This is mitigated by the base program review and the review of the "extremely valuable or urgent" category. It is also offset by the enhanced opportunity to influence these trade-offs in the projects selected for intensive review, which, realistically, are the only ones where decisions can be influenced anyway.

f. Conclusion and Recommendation

This alternative approach is presented as a suggestion for consideration and discussion, not as a recommendation for action. The review committee is mindful of the great effort and careful thought that have gone into the existing system. It offers this suggestion diffidently and seeks to avoid presumptuousness in doing so. However, there was enough evidence of wasted effort, fruitless paper exercises, and cynicism about a process that did not seem to change anything to sensitize it to the possibility that a more targeted decision system might be preferable.

V.B.4. Restructuring the RDS/ADS Formats to Encompass Alternatives and Streamline Preparation Effort

a. Problem

There is a significant redundancy in the current RDS/ADS information requirements and hence a need to streamline the RDS preparation effort if both are to continue to be used.

b. Background

Although the RDS and ADS have evolved separately, they contain several data fields asking for the same or similar information. This issue was also raised in the Tier-2 report (CRESP, 1996). Regarding the RDS itself, if the recommendations of V.C.15 to reduce the number of ranking lists are adopted, the number of "before," "during," and "after" discussions in the RDS can be reduced. In addition, it is desirable in certain cases for budgetary decision-making to consider an alternative way of meeting a specific objective, and to score both the proposal and the alternative as to their risk-reduction value and value-to-cost ratio. The potential benefits of using a value-to-cost ratio for this purpose are discussed in section V.C.18.

c. Recommendations

i. A modified and streamlined risk information and scoring document is necessary if risk is to be efficiently incorporated into the ten-year planning process. If the RDS's/ADS's are the point of departure for that document, then the scope of the RDS should be changed as recommended in sections V.B.1 and V.B.2 and the feasibility of elimination of the ADS should be considered.

ii. If the section V.C.15 recommendations are adopted, reduce the number of "before," "during," and "after" narratives to a maximum of four: public, worker, and environment risks, and one other major "driver," e.g., mortgage reduction.

iii. Consider removal of the Environmental Safety and Health (ES&H) narratives and other material not essential to the scoring outside the RDS process, in a manner similar to that recommended for site-wide min-safe services.

iv. It is desirable to consider alternative ways of meeting a specific program objective as early as possible in the budget review process. Toward this end, the format of the RDS should be restructured to include the option of considering and scoring major alternative ways of meeting the specific objective. Since use of a value-to-cost ratio could be a useful basis for comparing alternatives, a value-to-cost field could also be added to the RDS.

v. Utilize the project description, milestone and cost data in the Supporting Data Worksheet (Attachment IV) of the 10-year plan, and include in the RDS only the risk discussions and scores relevant to the project.

vi. Append the "new" RDS to the Supporting Data Worksheet. (See also V.B.2; recommendation ii).

V.B.5. Consideration of Alternative Management Strategies

Throughout this report, various aspects of the MEP are discussed, and a wide variety of issues has been identified. This section suggests approaches for evaluating alternative strategies for comparing activities within and among sites, especially with respect to public safety.

The following presents a brief description of approaches which, in combination, will help to improve the system, and the transparency of the system, for evaluating and inter- comparing EM activities.

a. Refocusing the attention of the scoring process onto cross-site comparisons of activities that are at the budget margin for each site

A large effort has been put forth by DOE headquarters and site personnel to score over 1400 RDS's. The ultimate objective of the process is to "value" each activity and establish the relative priority of each activity within a given site, and eventually among sites. For most activities at a given site, the value is self-evident and there is little debate regarding the need for the activity or its budget. Accordingly, the need to score each and every activity is questionable. The real need is to create a system that values and intercompares activities that are of uncertain value and fall at the margin of the budget cutoff. Effort is needed to identify and evaluate systems that will allow a rapid screening of activities and the focusing of resources on those activities that are marginal. A more detailed discussion of this issue is provided in section V.B.3.

The starting point for the effort would be the optimized priority lists for each site and then identifying those activities that fall close to the budget allocation boundary. For example, the activities that are within 20% of the planning level cutoff would be the subject of the initial round of investigations. The effectiveness of the MEP and alternative scoring systems would be evaluated with respect to valuing these activities in a consistent and transparent manner.

b. Use of an objective-based, as opposed to an activity-based, scoring system.

Section V.B.1 demonstrates that the MEP has been of limited effectiveness in establishing a consistent score for public safety. In addition to improvements in the guidance and training and a greater commitment to the MEP process, as recommended in the Tier-2 Report (CRESP, 1996), this section also demonstrates that some modifications to the structure of the MEP may be needed to resolve the consistency problem, and that one of the reasons for

the limited effectiveness of the MEP is the variable scope of the ADS's upon which the RDS's are based. In order to help resolve this issue, the feasibility of scoring the objectives of a given set of related activities (as opposed to scoring the individual activities themselves), needs to be evaluated.

The evaluation would involve extending the work begun in section V.B.1. This would involve trying to group activities into a limited number of objectives for each site and then scoring the objectives. The purpose of the exercise would be to determine whether comparisons of objectives, as opposed to comparisons of activities, could be more effective in linking the budget to risk and making meaningful comparisons of the various activities within and among sites.

c. Improving the definition of min-safe and other site-wide programs and the need to separate these programs from the scoring process

Sections V.B.1 and V.C.14.b reveal that many of the RDS's support site-wide activities, as opposed to specific activities related to environmental restoration and waste management. These activities include site-wide health and safety programs, surveillance and maintenance programs, security and safeguards programs, infrastructure programs, fire protection, emergency response, and a broad range of administrative and management functions, including the personnel and support budget. These RDS's are generally assigned a high priority in the optimized priority lists because, without these services, none of the other activities and programs is possible. In effect, these site-wide activities are "automatically" included among the activities that will be budgeted. This being the case, is there a need to score these activities and assess their value in the same way that the other activities are scored?

Effort into defining, defending, and budgeting these site-wide services utilizing a system separate from the system used to value individual EM activities is needed. Included in these investigations would be an assessment of the degree to which a broad range of diverse activities are bundled within the scope of individual site-wide ADS's and the need to segregate site-wide activities according to objective.

In a related issue, many of these site-wide activities can be defined as "min-safe," and, according to the MEP guidance, "institutional, administrative and maintenance program controls are assumed to be continuous for an activity at its specific site for as long as they are needed (e.g., restricted public access, worker safety and health programs, etc.)." As such, the score for a given activity will depend on the assumptions used to define the extent of min-safe programs. The assumptions regarding min-safe that were used to score individual activities, and the degree to which the scores depend on those assumptions, should be evaluated.

d. The need for, and feasibility of, performing quantitative risk assessment to support the scoring of public risk

A detailed review of RDS's from many sites reveals that many of the activities supported by the RDS's are fundamentally different from the perspective of the type and magnitude of risk they pose to the public. Specifically, the activities can be grouped into the following categories, each category representing a unique challenge to scoring risk:

i. Clearing the existing backlog of wastes in storage
ii. Developing new storage, treatment and disposal facilities to help clear the waste backlog and manage future wastes
iii. Maintaining existing facilities for waste storage, treatment, and disposal
iv. Decontaminating and decommissioning existing structures
v. Remediation of contaminated natural resources, including land, surface water, and groundwater

In each case, it would be desirable to characterize exposure and risk to the public with regard to the parameters described in scoring high-end lifetime individual risk, collective risk,time and duration of exposure, probability of exposure, and potential for intervention.

Activities associated with clearing the backlog of existing waste in storage are of public safety value because the waste inventory represents a continuing threat if the material is released. In many RDS's, such activities are given high priorities because of the perceived high risk posed by such releases. However, without a quantitative risk assessment, such judgements may be grossly in error. In fact, it is not always immediately apparent that the risk posed by the activity itself, and the residual risk associated with the waste in its new and improved setting after cleanup, represents a net reduction in the overall risk to workers and the public. Ways to provide a quantitative assessment of the risk to the public and workers posed by stored waste prior to, during, and following activities designed to clear the waste backlog should be explored.

The studies would involve identifying a selected number of RDS's representing several sites and waste forms, identifying alternative risk screening models, and then selecting a limited number of models for application to the selected RDS's. The results of the assessments would then be evaluated in terms of their robustness and usefulness with regard to characterizing the "before," "during," and "after" risks to workers and the public. The work would also include a review of existing CERCLA and NEPA documents to determine the degree to which risk assessments provided in these documents may be used directly, or with modest modification, to characterize risk.

The second category of RDS's addresses the development of new waste treatment, storage,

and disposal facilities. The worker and public risks for such activities are different than those of the first category because the consequences of "no-action" are less immediate. A decision not to develop new facilities would indirectly increase risk because the waste would need to be treated, stored, and disposed of by some other means, which may be less reliable and permanent than the planned facilities. Methods for quantifying the potential "ripple" effects of not establishing new facilities for waste treatment, storage, and disposal should be investigated.

The investigations would involve selecting representative waste treatment, storage, and disposal RDS's and then assessing the range of possible consequences associated with not developing the new facilities. These consequences may already be documented in various NEPA documents. This information would then be used to quantify the risks to workers and the public for the "before," "during," and "after" scenarios associated with the development and non-development of the new facilities.

The third category differs from the first two in that it is concerned with the consequences of not maintaining existing storage, treatment and disposal facilities. Such facilities contain an existing inventory of waste, which, if not maintained, can be released and result in an increased risk to workers and the public. Work is needed on developing screening methods for quantifying these risks.

The work would involve selecting representative RDS's for maintaining existing waste treatment, storage, and disposal facilities and then assessing the range of possible consequences associated with not maintaining the facilities. As in the other categories, screening models for this particular application would be reviewed, and then selected models would be applied to assess the impacts on workers and the public for before, during, and after the planned activities.

The fourth category is concerned with the quantification of the risk reduction associated with planned D&D activities. The work would involve identifying representative RDS's and then selecting and applying models to evaluate the risks to workers and the public associated with not decommissioning versus the risk associated with decommissioning. The analyses would determine the feasibility of using existing NEPA documents to make these determinations versus the application of existing simple screening models.

The last category pertains primarily to Environmental Restoration (ER) activities related to CERCLA, UMTRA, and FUSRAP. These activities are designed to remediate soil and groundwater contamination primarily in the public domain. These investigations differ from the others because the contaminants are already off-site in occupied or potentially occupied areas. As such, the assessment of risks involves different modeling scenarios and assumptions.

The work would involve identifying the RDS's that fall within this category and determining the degree to which the public and worker risks have already been quantified in either RI/FS, NEPA, or other planning documents for the programs. It is anticipated that such analyses exist and can readily be used to quantify risks associated with these categories of activities.

V.B.6. Clarification of the Process in Relation to EM's "10-Year" Plan

During the IRB meeting, Mr. Alm described the vision and operating principles for the future EM budgeting process. The goal of the IRB is to establish a budget that will eliminate EM major risks and mortgages in ten years. He explained that a $250 billion program spread out over 75 years is neither manageable nor politically viable. In addition, in order to better predict and control costs, Mr. Alm made reference to several initiatives, including:

right-sizing
reducing overhead costs
privatization
performance-based contracting
outsourcing

Each presentation at the IRB explicitly addressed these initiatives and the degree to which the "ten-year" objective can be achieved. However, there was very little discussion on how these changes in the planning basis for the EM program may impact the cost/benefit balance for the various activities. Specifically, these programs are designed to reduce overhead, be completed in a time frame that is much shorter than originally planned, and privatize and out-source as much of the work as possible. Some of the issues raised by these new initiatives, as they relate to worker and public health and safety, include the following:

i. The new initiatives should result in a significant increase in construction-related activities over the next ten years. Is there experience within the Complex for a similar level of effort, and what assurance is there that worker safety will be assured under these new initiatives?

ii. The DOE has enjoyed an approximately three-fold lower occupational injury rate than the commercial sector (see Figures V.B.6-1 and V.B.6-2). In the process of reducing overhead and privatizing work, will the differences in worker risks between DOE and the commercial sector diminish?

iii. One of the strategies being employed to reduce costs and "get the job done" is to decommission facilities in place and establish on-site disposal facilities.These developments in the vision for each site represent a potential increase in the long-term impacts on the public and the environment in the

> vicinity of each site. In addition, these potential increases in long-term risk may be offset by a reduction in the short-term risks associated with the removal, treatment, packaging, shipping, and disposal of the material at other centralized locations. These issues were addressed on a national level in the Waste Management Program Environmental Impact Statement (WMPEIS) and are being addressed in site-specific Environmental Assessments and Environmental Impact Statements. To what degree are these trade-offs captured by the MEP and factored into the budget allocation process?

The ADS's and their associated RDS's are not designed or intended to capture these trade-offs. In its current form, the MEP is designed to simply disclose the costs and benefits of various activities, but not provide justification for the selection of the specific activities, as opposed to alternative activities (see section V.B.1). The question is, is there a need for, and a vehicle for, linking the various activities that are being scored to the vision for each site and the rationale for selecting that specific activity (or strategy) for achieving the vision?

Effort is needed into evaluating "how far" can and should the MEP go toward justifying the budget. Should it, and can it, somehow demonstrate that each activity is the end result (at a given point in time) of an integrated process that has considered a broad range of alternative strategies for accomplishing the vision for the site, which itself is subject to change? Such a linkage would help to segregate what is more important from what is less important and place each activity within a broader context.

Table V.B.6-1

Table V.B.6-2

V.B.7. Consideration of Environmental Indicators of Progress of the "10-Year" Plan

a. Background:

It is important to the continued funding of the EM effort to demonstrate meaningful waste management and environmental restoration progress. The memorandum from the Assistant Secretary dated June 10, 1996, on the 10-year plan included an Attachment 3 for this purpose.

There is substantial effort going on between states and the Environmental Protection Agency (EPA) to develop meaningful indicators of progress for a variety of programs that are funded by federal grants. The thrust of those efforts is to move away from procedural and document measures to parameters that are directly reflective of environmental conditions. A number of these "environmental indicators" may be applicable to the EM program; however, parameters specific to radionuclide issues have not yet received attention.

For example, annual reduction in risk or mortgage could be one such indicator, but it would be measured and tracked separately and differently (as to baselines) from the risk evaluation and score used to rank the specific program objective for funding purposes (see section V.B.2). If risk reduction is to be used, a number of preparatory efforts need to be undertaken.

b. Recommendations:

i. Identification of Indicators

The above efforts with various states should be reviewed to determine which indicators might be useful to EM. In addition, indicators for radionuclide problems should be developed independently for DOE consideration.

ii. Considerations Regarding Use of Risk Reduction as a Progress Indicator

Risk reduction could be a useful and powerful indicator of EM progress. To use it appropriately, however, several issues need to be addressed. First, it should be recognized that as projects proceed, additional risk assessment information and analysis often becomes available, e.g., through NEPA, CERCLA, or RCRA documentation requirements. However, before such analyses can be utilized to support Department-wide risk measures of progress, a consistency review of the risk assessment assumptions being employed in the various documents should be undertaken. This review would cover the use of baselines, exposure scenario and receptor assumptions, and other relevant factors. Areas of inconsistency and redundant conservatism would be identified, and recommendations made to correct those

problems. For example, the use of the "maximally exposed individual" as a receptor might give way to a more realistic, but still conservative, assessment of individual and population risk, as adopted by EPA in their revised "Exposure Assessment Guidelines."

Secondly, the development of a common measure to present progress on the reduction of cancer and non-cancer risks should be considered, in addition to those measures currently in use.[2] Such a measure might be the margin-of-exposure ratio currently being used by the EPA for noncarcinogens and carcinogens with non-linear dose-response characteristics. This ratio is the dose derived from a tumor bioassay, epidemiologic, or biological marker study, such as the dose associated with a ten percent response rate, divided by the actual or projected human exposure. The determination of an acceptable margin-of-exposure ratio is a risk-management function requiring consensus-building.

The use of such a ratio may have several advantages. It provides a common measure to present risk reduction progress on a broad range of diverse toxic substances, including radionuclides. It bypasses unresolvable debates over low-exposure health effects, and as a risk management tool, fosters stakeholder involvement in assessing progress and in deciding how much progress in risk reduction is needed and warranted (essentially the "how clean is clean" decision). Therefore, its potential use as an indicator of EM progress should be investigated.

Finally, consideration should be given to a choice between having a focus on risk reduction, or continuing to focus on residual risk, in comparison to other similar risks. Particularly for radioactivity, comparisons to natural radiation background should be considered to keep risk reduction and risk endpoints in perspective.

V.B.8. Comparative Analysis of Alternative Ranking Models

a. Background

The simplicity of the MEM is attractive because it fosters broad understanding of the process and stakeholder participation. Its effectiveness and utility deserve to be evaluated periodically in relation to the various other priority ranking models which have been used within DOE , e.g., the Capital Assessment Management Program (CAMP), the Laboratory Integration Priority System (LIPS), and the Risk-Based Priority Model (RPM), and others proposed, e.g., the Environmental Restoration Priority System (ERPS). There may also be

[2] See Risk Assessment and Risk Management in Regulatory Decision-Making, Commission on Risk Assessment and Risk Management, draft report, June 13, 1996; pages 19-22

others outside the Department that might be applicable to the DOE budgeting problem.[3] A discussion of some possibly useful models is provided in Priority-setting D.

b. Recommendations

In light of the above, it is recommended that further work on model capability and comparisons be undertaken.

In addition, in support of the recommendation in V.C.18, it would be useful to select a set of program objectives and rank them using the MEM "value" approach and the value-to-cost ratio approach suggested. Differences in overall benefit achieved could then be determined, for various levels of overall funding, to ascertain the effectiveness of the value/cost approach.

V.B.9 Enhancement of Stakeholder Involvement

Stakeholder involvement in the budget process does not occur in isolation. It takes place in the context of established procedures and expectations for involvement and of current and previously resolved issues in which stakeholders, EM, and field offices are or have been engaged.

a. Barriers to effective involvement

Since its founding, EM has worked with increasing success to improve relationships with its stakeholders -- people who are interested in or affected by its facilities and activities. Headquarters staff is now responsible for involving the public in national level issues and for providing policy, goals, guidance, and assistance to the field offices. The details of implementation of involvement at the facility level are the responsibility of field offices. This division of responsibility is reflected in the Headquarters level Environmental Management Advisory Board (EMAB) and the facility level Site-Specific Advisory Boards (SSAB's). This seems a sensible way to divide responsibility since the facilities and their stakeholders are so diverse.

When the process or issue is one that is initiated and led by Headquarters but implemented by the field, as is the RDS process, the effectiveness of field office public involvement will likely depend on:

i. Clear communication by Headquarters to the field of the nature and content

[3] See, for example, A Comparison of the ES&H Risk-Based Priority Model (RPM) and the Laboratory Integration and Prioritization System (LIPS); Robert Anderson and Michael A. Voth, March, 1996.

of the process or issues in which public involvement is to be sought. Preparation of RDS's and their use in the budget formulation is an evolving process. Indeed, Headquarters revised its guidance several times during the 1998 budget process. Stakeholders who wished to be involved found that field personnel could not explain and sometimes said they did not understand the overall process and its purpose. How do RDS's fit in with the other decision-aiding or project-management paperwork? ADS's, ROD's, WBS's, FFA's--all the alphabet soup people were beginning to understand was now joined by RDS's and MEMs. What was their purpose? How should stakeholders spend their time? The number of RDS's was overwhelming at some field offices and the time short.

This confusion is one price an organization and its stakeholders pay for trying to meet the laudable goal of involving people early, when policy is being formed. However, confusion that overwhelms and discourages people is not helpful. At the very least, the field offices should have been provided with a fact sheet to refer to and to give to stakeholders explaining the new process and its purpose. The fact sheet could have explained that the process was evolving and subject to change, but the goals should have been clearly stated. Field office personnel lost credibility when they could not answer basic questions about purpose and goals. They also lost credibility when they submitted revised forms to Headquarters based on revised instructions, *after* stakeholders had reviewed and commented on RDS's and priority lists and thought they were final.

ii. Agreement among Headquarters, the field, and stakeholders about the relative importance of stakeholder involvement in a specific process or issue and compatibility with previously scheduled involvement. Field offices involve stakeholders in an increasing number of issues. National Environmental Protection Act (NEPA) and Comprehensive Emergency Response, Compensation, and Liability Act (CERCLA) have specific requirements. Field offices are developing or have recently developed land use plans. The SSABs have full agendas. Stakeholder burnout is now an issue. How can stakeholder time be used more effectively to meet EM and stakeholder goals?

Budget preparation and priority-setting are fundamental decision processes, and people will want to be involved in them. Many stakeholders appreciated the opportunity to participate in the FY 1998 process, in spite of the difficulties, and felt the explanations managers made about how they ranked activities were helpful. But are RDS's going to be the key? Should a person or group try to understand them all, or concentrate on a few? Will they be so

changed next year that time spent now to understand them will not be well spent? Or if a person or group doesn't get a thorough understanding now, will they be unable to protect their interests next year? These kinds of questions need answers if field offices and their stakeholders are to use their time effectively.

b. Policy issues affecting stakeholder involvement

Priority-setting is a crucial activity and a sensitive topic. There have been a number of false starts and some successes at field offices. Stakeholders, particularly regulators, have insisted on a role in establishing priorities for cleanup. A review of the history of the opening up of the Weapons Complex to outside review from the 1984 LEAF vs. Hodel decision until now reveals a constant interplay of legal and political forces centering around how decisions will be made and on what basis. Regulators and DOE have signed agreements in place that specify goals, milestones, and penalties.

Before field offices can effectively involve stakeholders in risk-based priority-setting, DOE and stakeholders need to reach an agreement or understanding of disagreements about the role of risk and other factors in priority-setting, and how those factors can be balanced. They need to discuss why a new process is needed. Many contend that facility agreements, as they have been renegotiated, increasingly take risk into account within regulatory requirements. In addition, some field offices and their stakeholders have established relatively formal, open, priority-setting processes. There is a great deal of vested energy and interest in these established procedures. Stakeholders are both wary and weary when confronted with yet another priority-setting scheme.

DOE should engage stakeholders in a discussion about how it intends to use RDS's in priority-setting and how that process relates to established processes. The discussion needs to include the reason for the new focus on risk in setting priorities, how that can best be done (RDS's, agreement renegotiation, etc.), and how other factors (for example regulatory requirements, industrial development, and mortgage reduction) can or should be incorporated into priority-setting. Without explicit agreement about these issues, they will lie below the surface and erode, discredit, or sabotage any risk-based priority-setting process.

c. Stakeholder effectiveness

In spite of the difficulties alluded to above, many stakeholders and stakeholder groups were able to make insightful comments about RDS development and MEM rankings. These comments raise many of the same issues as does this report. The involvement of dedicated, concerned people is a valuable quality improvement tool. It should not only be valued, but nurtured by careful planning and respect for people's time. Policy documents show that DOE

is aware of that and has made considerable efforts to ensure that public involvement programs reflect respect for the public. But, from the stakeholders' vantage point, when demands are placed on their time for involvement in what seems a poorly understood, conflicted process, it seems doubtful that DOE has adequately considered what that policy means to those who implement or are affected by it.

Also, to enable -- or empower -- stakeholders, demographic differences must be understood and factored into the long-term management process, and the relevant information resources should match these differences and associated needs. Important in this context are long-term monitoring of signal events such as health status, pollutant levels in surface and ground-waters, land use changes, construction technologies, and ecological changes. Such information, and the capability of its translation into lay language, should ideally be disseminated through permanent adducts within the existing social structures of the stakeholders themselves.

V.C. Specific Elements and Areas for Potential Improvement

Deficiencies in the completeness, quality, and documentation of the information contained in the Risk Data Sheets (RDS's) and in the data that are called for in the "Management Evaluation Matrix" have been noted by the National Review Panel (CRESP,1996) and should be addressed if use of the RDS's and MEM is to be continued in the future. The same issues are not reviewed in comparable depth herein, but the following comments are offered in the hope that they may contribute to further improvement of the budget formulation process.

V.C.1. Enhancement of the Criteria for the Scoring of Risks to Public Health and Safety

In the Fiscal Year 1998 Budget Formulation, the EM program has listed several key elements in its process, which include the integration of risk information, the establishment of integrated priorities, moving toward the goal of a budget that is based on performance, and the important role that stakeholder involvement has in the process.

The EM top priority is to reduce urgent risks in all cases but especially those which are related to plutonium, tank waste, and spent nuclear fuel. A vital component of these efforts pertains to risks to the off-site public that reside, visit, and frequent the vicinity of DOE nuclear facility sites scattered throughout the contiguous United States. This effort uses Risk Data Sheets (RDS's) which evaluate seven categories of risk including Off-Site Public Health and Safety (PS). The assessment of risks for Off-Site PS consists of systematic consideration

of the source terms, their release pathways, environmental distribution and behavior, impacts on receptors, and the likelihood of occurrence. This process utilizes current information and data coupled with the appropriate measurements and suitable modeling.

A critical part of the assessment is the availability and use of consistent and reasonable assumptions, relevant boundary conditions, source characterization data, and comparable and consistent criteria for the assessments that are performed for various waste types in different facilities at numerous geographical sites.

This review concurs with the major conclusions of the CRESP Tier-2 assessment which is presented in the "Review of Risk Data Sheet Information for Fiscal Year 1998." Of special importance is the complete concurrence with the usefulness of risk management and assessment as a powerful tool in the EM planning and decision-making process, including the establishment of a performance-based budget and integrated priorities. The RDS iterative process must be continually revised and improved so as to provide and maintain a high-quality system which undergirds the EM Budget Formulation process.

The following comments refer to a number of areas in which deficiencies are noted and in which improvements need to be made to enhance the quality, completeness and effectiveness of the risk process as it relates to the Public Health and Safety category and perhaps other elements of the EM program.

The guidance from EM should be more detailed and more explicit. For example, more specific guidance should be given in scenario development for various evaluation categories. The current guidance allows too much flexibility in terms of interpretation by the various DOE field and operations offices.

The criteria of "before," "during," and "after" need clearer definition. In the current guidance, the following words can be found: "The data in these columns is representative of the risks before implementing the RDS activities (or the risk of not implementing them)" and "The Before condition establishes a situation where the activity described in the RDS is not completed." This later statement of "Before" appears to agree with the "During" definition of "The data in these columns is representative of the risks experienced during the implementation of the activity." The activity is clearly and inherently "not completed" if it is being implemented.

In a similar manner the rankings of "High" (H), "Medium" (M), and "Low" (L) for the seven major risk categories need to be quantified as to their relative magnitudes. Perhaps ranges of effects could be used to project the differences in impacts.

Another need in the guidance is a better definition of land use and other boundary conditions.

The PS risks are greatly impacted by land use criteria and those used for Minimum Safety Requirements.

As mentioned previously, there is obviously a problem with the wide variability in RDS's from site-to-site. Part of this can be attributable to the lack of prescriptiveness, clarity, completeness, detail, and consistency in the EM guidance and perhaps the need for more specific training in the process. However, most of it can be attributed to the broad flexibility delegated to and demonstrated by the EM field operations in responding to the RDS process. For example, there are several cases where seepage basins and separation basins at the SRS, with relatively small source terms, small probability of major accident occurrence, and relatively low potential for risks to the Public Health and Safety, are assigned risk levels for PS of "H" and "H" for "Before" and "During," respectively, when compared to the K-65 Silos ("H" for "Before" and "M" for "During") at Fernald and the K Basins at Hanford ("H" for "Before" and "M" for "During"). These appear to be rankings for risk to PS which are grossly inconsistent with any reasonable set of criteria. Situations such as these must be identified and fixed in order to improve the quality of the RDS's and to improve and strengthen the risk management and assessment process.

There are a number of inconsistencies in the use of radiological terminology. Examples are: use of "rems" for collective (population) dose rather than "person-rems:" the discussion of collective dose *without* an indication of the numbers of people impacted; lack of a clear definition of when cancer risk is the cancer risk for incidence or fatalities; non-separation and specification of the amounts of Cs-137 and Sr-90 contained in 73 million curies; use of radiation doses to Maximally Exposed Individuals (MEI) off-site with no mention of population dose or to the numbers of people involved; and use of an open ended and non-specific term such as the MEI dose in the "After" conditions is "assumed to exceed 1 rem for off site and 5 rem to the on-site MEI." These inconsistencies in terminology combined with incompleteness make the interpretation of resultant risks very difficult, if not impossible, without making clarifying assumptions or obtaining other relevant facts.

The guidance for Public Health and Safety specifies that "This impact should be chosen when a potential result of a condition being evaluated could lead to permanent disability (loss of limb, sight, hearing) or loss of life by one or more members of the off-site population. This impact includes deaths and disabling injuries, as well as future cancer deaths or genetic damage and effects that might result from releases of hazardous or radioactive materials that breach the site boundaries." It is recommended in addition that the guidance for radiation effects specifically include fatal cancers, non-fatal cancers, and the genetic effects for the first two generations. These are stochastic (probabilistic) radiation effects for which DOE approved health effects factors are available. This would make the reporting of radiation effects and their risks more systematic and consistent and utilize readily available data from the sites, obtainable by measurement or from pertinent modeling. Risks from the effects of

hazardous materials should be handled in a parallel manner.

This problem is somewhat exacerbated by the fact that the considerations and issues which affect risk to the Public Health and Safety are inherent and important to a number of compliance matters. They deserve the best efforts the system can produce to assure high-quality products and performance throughout the EM program.

V.C.2. Enhancement of Criteria for Scoring Risks to Workers

The risks to workers during DOE EM activities are numerous and varied, but the management evaluation instructions fail to recognize their range and complexity or to provide guidance on entering much of the pertinent information needed for the interpretation of risk data sheets.

a. At a minimum, there should be discreet entries that distinguish among:
   - routine operational exposures ("before" or other steady-state maintenance operations)
   - periodic elevation of exposures (scheduled remediation activities with displacement or disturbance of inventories of hazardous wastes)
   - unscheduled emergency events (explosions, chain reactions, fires, breach of containment, etc.) and their estimated likelihood or frequency

b. In each of the above categories, there should be explicit ratings for:
   - traumatic injury
   - chemical intoxication -- acute and chronic
   - ionizing radiation -- acute and chronic

c. For each occupational cohort, there should be explicit entries for identifiable factors affecting current or potential exposures, such as:

   - status and maintenance of engineering controls, access barriers, confinement, and emergency systems
   - provision of appropriate personal protective equipment
   - health and safety training and continuing education programs
   - number of workers at risk
   - opportunities for risk reduction

   Guidance on a format for entry of such exposure determinants into an occupational exposure database is available in a recent report prepared by a joint American Conference of Governmental Industrial Hygienists-American Industrial Health Association (ACGIH-AIHA) Ad Hoc Technical Committee on Occupational

Exposure Databases (Appl. Occup. Environ. Hygiene, in press).

d. The transference of risks to workers associated with removal of wastes from maintenance and storage sites, their processing, and transportation to new off-site repositories needs to be more explicitly addressed in terms of:

- increased risks created by the exposures of the on-site workers involved in handling and processing the wastes
- increased risks created to transport workers along transit routes to new repository sites
- increased risks to workers at the new repository sites
- risk reduction achieved at and around the original site from wastes *in situ*

The risks to on-site workers at the original site may be similar for on-site stabilization and for removal to another site. In any case, the overall risk to society needs to explicitly consider risk transference as well as *in situ* risk.

V.C.3. Enhancement of the Criteria for Scoring Impacts on the Environment

Ecological risks of significance are generally related to long-term and large-scale patterns of exposure to toxicants. These occur when off-site migration of persistent and bio-accumulative chemicals exist over a period of time. Radionuclides, mercury, dioxin, and polychlorinated biphenols are biological chemicals of concern (BCC's) and are associated with DOE facilities.

The risk analysis process must involve estimates of transport, transformation and exposure, as well as hazard characterization of each toxicant. Little effort was spent on characterization of each toxicant and even less effort was spent on characterizing off-site ecological impacts. It is well known that many DOE facilities have experienced off-site releases since the 1950s.

The individual species at risk that have immediate social significance include endangered species (on-site and off-site) and commercial and recreational fish and wildlife (hunting and fishing) populations. Much of the negative impact of exposure to toxic chemicals is the preemptive loss of economic benefits through restrictions on commercial and recreational use of the natural resources. These analyses of ecological risk are conspicuous by their absence.

The assessment endpoints for ecological risk assessments can vary from biological impacts at the individual, population, community, and ecosystem level to socioeconomic impacts involving benefit/cost, property rights, portable water supplies, recreational opportunities and future land use opportunities. Again, these are generally lacking in these RDS sheets.

V.C.4. Enhancement of the Criteria for Scoring Social, Cultural, and Economic Impacts

As detailed in the report of the National Review Panel, "Review of Risk Data Sheet Information for Fiscal Year 1998" (CRESP, 1996), the social, cultural, and economical field of the RDS was adequately dealt with in (almost) none of the RDS's examined. The explanation may lie in the formulation of the field itself.

a. Coverage of the field

The economic component of this field is not defined by traditional cost/benefit quantitative analysis, which in any case may not be possible or appropriate. It may be measured by quantification of changes in types of economic activity, such as industry categorized in Bureau of Labor Statistics (BLS) or Gross National Product (GNP) data, goods transport, or energy consumption. This kind of information cannot yield values commensurable with biological data and, therefore, cannot be used in the same value calculus. It may, however, be displayed as a separate decision-making factor in the political process in which stakeholders participate.

The social component, likewise, can be analyzed using values or measures of social structure, such as housing and ethnic data from the census tract compilations, albeit with the same limitations and used in the same way. Care should be taken in merging these data with those taken from demography to avoid simple averaging of population densities by social (stakeholder) group, to take into account styles of urbanization such as population clustering or dispersion in agricultural communities associated with social structure.

This leaves the "cultural" component, which includes the special problems posed by sites of traditional fishing, hunting, and agricultural practice, and by cemeteries, historic burial grounds, and ceremonial or sacred places. These places have a physical existence (that is they exist in a specific place) and their continued existence or continued ability to perform their culturally-valued function may be directly threatened by contamination or actions taken to clean up contamination or manage waste. Like the other factors in the field "social, cultural, and economic impacts," the risks to these sites can be described on an RDS in concrete terms tied to a specific location. While such cultural sites and artifacts may not be numerous, they can be of critical importance where they exist.

Recommendation: Coverage of the field is possible by choosing signal artifacts, the presence, absence, or quality of which permits an approximate inventory of the relevant social, economic, and cultural factors. Social, cultural, and economic impacts on the ecology of the human niche are also fruitfully analyzed in conjunction with the analysis of past, present and projected demographic and land use patterns and their impacts on indigenous and overlapping or successor populations.

b. Identification of Impacts

The guidance distinguishes between significant adverse impacts and moderate adverse impacts on two dimensions, which is methodologically confusing. The first is the presence or absence of organized protest or unfavorable media attention; the second is the capacity (and cost) to mitigate. There are a number of difficulties with this formulation.

i. The Presence or Absence of Organized Outcry

The presence or absence of organized outcry is a flawed basis for defining severity of impact. No self-respecting government will act contrary to the deeply-held wishes of a portion of its population based on whether it can "get away with it." Further, that course leads to loss of trust; in turn, that makes future (quite likely) reactions that much more severe. The decision should be taken based on a best estimate, with stakeholder input, of the intrinsic severity of the loss of social-economic-cultural values. In practice, this depends on whether the impact is central to the value system offended or peripheral to it. In coming to see this judgement, the best guidance is that "you know one when you see it."

Recommendation: Only those violations of social-economic-cultural values that are central to a value system (all of them) should be considered candidates for classification as "significant adverse impact." All others will be candidates for classification as "moderate adverse impact."

ii. The Second Criterion, Possible Mitigation

The second criterion, possible mitigation, should come into play only after the first determination is made, relieving the methodological ambiguity in the current guidance. Full mitigation of significant adverse impacts will seldom be possible. Partial mitigation may be possible, however, even to the extent of downgrading the impact to "moderate." The options for mitigation to be included in the decision set should include all fiscally responsible actions (as judged by community standards fully informed of the value system) necessary and possible to bring the impacts into the "moderate" range. These added costs may argue for avoiding the initiating event causing the impact. If no mitigation is possible to bring the impact into the moderate range, then the offending impact should be avoided unless a truly overriding national purpose is involved. Again, community standards can inform this decision. For residual significant adverse impacts, by definition, no compensation can make the impacted parties whole. For symbolic purposes, for equity, and as a discipline on decision makers, however, compensation should be paid such that the offended party shares significantly in the avoided cost/social benefit accruing from the EM action.

"Moderate" impacts are, by the definition above, compensable. Consequently, while

mitigation may be a preferred course, a balance should be struck which presents those impactedd and those with fiscal responsibility with a choice between mitigation and compensation (presumably in kind) at a level substantially below the cost mitigation. Fiscalscal responsibility dictates that the limits of compensation and of mitigation should meet community standards.

Recommendation: Mitigation and/or compensation options should be chosen with due regard to the significance of the impact. The options should also balance the losses borne with the national interest and with community standards on compensation or degree of mitigation, taking both fiscal responsibility and the duty to avoid inordinate sacrifice of individual and group values into account.

The impact of remediation on changes in the human niche, such as land use and occupational leisure patterns, needs to be recognized. Changes in population density and activity intensity are two measures. However, there are other changes that can only be recognized as sentinel events in the migration of indigenous and later peoples and the successional demographic patterns that result.

V.C.5. Consideration of the Need for Scoring Mission Impact

a. Problem

The relevance of an activity to a mission is an important consideration. However, the mission impact criteria formed by the two current criterion are very general, and their use in the MEM does not appear to have had a substantial influence on rankings.

b. Background

The inclusion of a mission impact criteria was apparently designed so that necessary activities without direct impact on values such as risk or mortgage reduction could nevertheless achieve some "value" in the scoring process. This is appropriate, but this needstemslargely from the current degree of segmentation of program scope reflected in the RDS's. If, as proposed in sections V.B.1 and V.B.2, RDS scopes are aggregated to the level of a specific program objective tied directly to the EM mission, then the need for the mission impact criteria in the MEM diminishes.

c. Recommendation

If DOE adopts the scope changes for the RDS's recommended in sections V.B.1 and V.B.2, then the mission impact component of the MEM can be deleted.

V.C.6. Enhancement of the Criteria for Scoring Mortgage Reduction

a. Definition and Background of "Mortgage Reduction"

Assistant Secretary Alm has included mortgage reduction in his list of seven principles (10 June memo), but in a slightly different form than in the previous guidance. The 15 November 1995 guidance included "Cost effectiveness, including mortgage reduction," based on the (12 October 1995) EMAB recommendation of a budget case that "reduces landlord costs to the greatest extent possible" on a discounted cash flow basis. The principle is to "reduce mortgage and support costs to free up resources for further risk reduction." The new 10-year plan horizon focuses on actions to reduce near-term risk, whereas the previous guidance was developed in the context of a program with a horizon of 50 years or more. In the latter, mortgage costs would be substantial. In the new case, support costs (which could be called mortgage costs) are near-term. Thus, the emphasis is now on transferring funding from support of existing activities to cleanup activities, recognizing also that "cleanup" has been defined more pragmatically.

Consequently, the mortgage reduction category is one of the crucial elements of the whole system. It should be expanded and emphasized commensurately. In doing so, one possible adjustment would be to evaluate the impacts not based on annual costs but on the present value of the streams of future costs to be saved. This would place mortgage reduction in the right context and eliminate the present ambiguity. Further, the mortgage reduction category should be holistic in its coverage and include future reductions in land costs, S&M, etc. in any evaluation.

b. Recommendation

The revisions to the 10-Year Plan Guidance memorandum of July 28, 1996 contained a well-thought out attachment on Mortgage Reduction Guidance that should be applied consistently across sites.

V.C.7. Enhancement and Documentation of the Criteria for Scoring Chemical Risks vs. Radiation Risks

As mentioned in section V.C.1, the guidance for completing RDS's calls for the assessment of numerous adverse effects which can be caused by the exposure of people to ionizing radiation and to hazardous chemicals. However, in reviewing numerous current RDS's from the DOE sites, it is obvious that much more care and attention have been devoted to radiation

effects than to those produced by hazardous chemicals.

Only in a few cases have hazardous chemicals been treated in any depth. In fact, in most cases, they have been essentially ignored. This leads to a complete imbalance in terms of trying to assess the effects of releases of radioactive materials and hazardous chemicals from various DOE sites. An example of assessing risks from hazardous wastes is presented in Appendix XI.E, "Radioactive and Hazardous Waste Transportation Risk Assessments" of "Draft Waste Management Environmental Impact Statement" (DOE, August 1995). Part II of this document presents a detailed analysis of risks which may occur when handling and transporting hazardous materials generated at DOE sites.

The EM program should devote more effort to documenting and assessing the problems which can be caused by the release of hazardous chemicals from DOE sites and their impacts on the off-site populations, as well as site workers.

V.C.8. Enhancement and Documentation of the Criteria for Scoring Acute Health Effects vs. Chronic Health Effects

Acute effects from radiation doses and exposures to hazardous chemicals are not seen in routine operations at DOE sites. Only under accident conditions would such effects be of concern. Even then, the accidents would need to be quite severe for such acute effects to occur and be observed.

Therefore, most of the interest in biological effects is in chronic effects which can cause cancer induction, both fatal and non-fatal, as well as genetic effects. These latter effects are frequently expressed and reported as those which will occur in the first two generations of progeny.

These types of biological effects are especially germane to considerations of risk to Public Health and Safety and to workers.

V.C.9. Consideration of Transportation Impacts

Many of the activities described in the RDS's can have an adverse effect on both the public and workers due to the transport of materials and wastes. In theory, these impacts can be scored as part of Public Safety (PS) and Site Personnel (SP) impact categories in the MEM. However, these categories emphasize the impacts of the release of hazardous materials before, during, and after implementation of the activities. The potential transportation

impacts associated with implementing a given activity are not consistently scored. Table V.C.9 presents a review of several RDS's where transportation of material is part of the activity, and identifies those cases where the impacts associated with transportation were or were not quantified.

Appendix XI.E presents an overview of the risks associated with transport of radioactive and hazardous chemicals by truck. The appendix demonstrates that default values for fatalities per vehicle mile are available and, with minimal additional effort, can be used to better characterize the potential health and safety impacts associated with activities involving the transport of large quantities of material.

Table V.C.9 Examples of RDS's Where Transportation Impacts are of Concern.

RDS	*Description of Transportation Issues*	*Did the RDS explicitly address Transportation Impacts?*
AL RDS96A0002 The remediation of uranium mill tailings in Grand Junction Co.	The remediation of over 4000 properties contaminated with uranium mill tailings will require the excavation and shipments of large volumes of soil and tailings. Part of the risk includes transportation accidents.	Yes A comprehensive analysis of transportation risks is provided, including the impacts of vehicular accidents.
AMES R96A0001, 0005, 0008 R95D0012 Waste management and remediation of contaminated soil	The waste generated is shipped for storage and disposal.	No Risks from spills during handling and transport are addressed, but not the impacts of vehicular accidents.

RDS	*Description of Transportation Issues*	*Did the RDS explicitly address Transportation Impacts?*
ANLW R95D0013, 0014 R96A0002, 0003, 0004, 0005, 00006 Remediation and disposal of hazardous and radioactive wastes and the D&D of facilities	The remediation of spills in the 800 area and other locations, the management of waste, and D&D activities will require the shipment of wastes for disposal	No A qualitative statement is made regarding the potential for construction and transportation type accidents. But assessments of transportation impacts are not provided.
ANLW R96A0001 Waste management and disposal associated with ANLW activities	Reference is made to off-site disposal of wastes	No
BNL R95D0004 D&D and management of waste R96A0001 and 0003 Radioactive and hazardous waste collection and disposal	Includes off-site disposal of D&D and radioactive and hazardous waste	No Reference is made to transportation safety, but no quantitative assessment of impacts is provided.
CH R96W0002, 0003, 0004 Removals at Site A	Several thousand cubic yards of contaminated soil needs to be removed and disposed	No
FN R96A0001 Remedial action and off-site disposal of waste	Hundreds of thousands of cubic yards of material will be removed, treated and shipped off-site for disposal	No

V.C.10. Enhancement of the Clarity and Consistency of Impact Scenarios with Respect to Assumptions Concerning Restrictions on the Use of Ground Water

The EM risk paradigm implicitly assumes that it is essential that either there be unrestricted access to uncontaminated groundwater resources or that underground plumes that are contaminated are unusable and must be made unaccessible to the public. Such assumptions are too simplistic. It should be made clear that there is little, if any, risk to the public when alternate sources of (clean) water are available to potential users of groundwater at comparable costs. Also, it may be economically and technically feasible for large users of groundwater to extract chemical and/or radionuclide contaminants from groundwater prior to using or distributing it. These options should be considered in evaluating overall risks and costs.

V.C.11. Consideration of Future Land Use Decisions

The guidance in place for the FY 1998 budget year calls for use of "current land use plans, consistent with other Environmental Management planning documents... when evaluating activities."

It is clear that land use is one of the most important determinants of exposure to contaminants and, therefore, is crucial in determining present and future risk. It follows that the land use assumption will drive a very large number of risk characterizations. The assumption of "current land use plans" is a fragile basis on which to make such crucial evaluations for two reasons. First, land use plans are not locked in place once and for all; they are subject to change, perhaps because of exogenous shifts in conditions, including population shifts. Second, land use plans are, or should be, made simultaneously with estimates of risks and of the costs of reducing those risks.

These considerations suggest that future land use be considered a control variable and not a constraint. In turn, this suggests that for many sites the option of changing prospective land use, with proper safeguards, be evaluated along with remediation options. The land use change option when made robust includes careful consideration of a number of factors including: 1) the practical difficulties of restricting access; 2) the present value of the long-term stewardship required; 3) the ability (and cost) to retrieve error if (however unlikely) failures of containment occur; 4) the possible added cost if desired land use in the future is determined to require a greater degree of cleanup; 5) the loss of value of land not available for other purposes (usually trivial as compared to remediation costs); and 6) the loss of value from the mere existence of unremediated sites, including effects on neighboring land.

From the perspective of assigning a score for Public Safety (PS) in the MEM, the assumptions

regarding future land use can have a profound effect on the score. For example, Hanford RDS R96N0053 supports the removal of degrading spent fuel from the K Basins and away from the Columbia River, in response to DNFSB Recommendation 94-1. The activity was assigned a PS score of 2B for "before" and 3D for "after" implication. The implication is that, if the activity is not performed, there is greater than about a ten percent per year chance that off-site individuals will receive excessive exposures, i.e., exceeding published exposure limits. After the action is taken, the PS score is reduced to 3D, which means that off-site exposures would not exceed published limits, and the likelihood of such exposures would be less than one percent per year. It would appear that this analysis is based on the assumption that the area along the Columbia River where the K Basins are located will remain under the direct control of the Department indefinitely, and not be released for alternative uses. Would the scores change if the vision for the site were to include eventually releasing land along the Columbia River for alternative uses? A coupled relationship appears to exist between the PS score for the activity "before" and "after" implementation, and how not implementing the activity could affect the future use of the site, which in turn, affects the PS score. These relationships need to be made clear in the RDS so the value of the activity can be more completely characterized.

Recommendation: The assumption of current land use plans should be considered a rebuttable presumption, not an absolute constraint. Two sources of alternative bases for decisions exist. First, there may be exogenously derived changes in land use which will affect exposure. Second, the economic cost or other effects from remediation that follow from the current land use plan may cause reconsideration of the plan which allows a simultaneous determination of land use and remediation goals.

V.C.12. Consideration of Technological Emergence Factors

a. Problem

Technology development has been identified as a critical need in achieving cost breakthroughs on remediation activities. Field-driven Site Technology Coordination Groups have been organized, but no written guidance was provided to the field on the cost reduction potential and time frames for emerging technologies that might influence timing decisions.

b. Recommendations

The inclusion of a value-to-cost ranking list, as recommended (see section V.C.18), would serve as an impetus to managers to bolster project rankings by reducing project costs. This will encourage further consideration of cost reductions that may become available from emerging technologies.

In addition, it is recommended that EM review these current RDS's and ADS's that involve projects with technological development aspects and provide comments to the appropriate program managers regarding opportunities for cost reductions or other benefits from emerging technologies being developed under EM-50 funding.

V.C.13. Consideration of the Societal Benefit Resulting from the EM Program

The Administration and the Congress have made a commitment to address the legacy of the cold war. This commitment has taken the form of an annual Environmental Restoration and Waste Management budget of about 6 billion dollars, or about 0.1% of the Gross Domestic Product. The overall EM budget will provide a return on investment that includes the return of property to productive use, the protection of the environment, the conservation of cultural resources, improvements in public health and safety, and the protection of workers. These benefits are difficult to quantify, but it is the responsibility of the EM budget allocation process to demonstrate that these resources are being managed to achieve the maximum return on investment. A review of the MEP guidance and many of the DOE core documents reveals that no attempt has been made by the Department to demonstrate that the activities that have the highest priority will, in fact, provide the highest return on the investment, especially with regard to public health and safety. The RDS MEM process falls short of providing the required level of assurance.

A recent paper in Risk Analysis (Tengs 95) tabulates over 500 interventions across all sectors of society. The paper reveals that, overall, the median intervention costs $42,000 per life-year saved. The median medical intervention (i.e., various medical surveillance and intervention programs) costs $19,000/life-year; injury reduction (i.e., various accident prevention programs) costs $48,000/life-year, and toxin control (e.g., various environmental protection programs) costs $2,800,000/life-year. However, the costs per life-year ranged from less than zero (i.e., both lives and money are saved) to over ten billion dollars per life-year. Studies by the Office of Management and Budget (OMB 91) and the Department of Transportation (DOT 84) reveal that investments in public health and safety programs often realize one to ten statistical deaths averted per million dollars invested. However, the costs range from $31,000 to $74 million dollars per statistical death averted. DOE should consider quantifying the public health risks averted by the various EM programs and activities in relation to the costs and comparing the derived ratios to those of other programs, such as those tabulated by Tengs. The assessment could also present the cost recovered in terms of returning land and facilities to productive use, and also the less quantifiable benefits, such as improvements in the environment and the return of valued cultural resources.

Part of this valuation process should also include consideration of the health risks to workers at the sites. These "costs" are part of the price to be paid for the benefits realized. Specifically, a large portion of the approximate 6 billion dollars per year invested in the EM

program will go toward the salaries of remediation and construction workers. The MEP should be used to help establish priorities such that the EM investment of about 6 billion dollars per year provides a public health return on investment, which will at least offset the adverse worker impacts associated with the investment. The importance of integrating worker risks into the prioritization-setting process for EM activities is expressed in finding 6.5.2 of the report of the Commission on Risk Assessment and Risk Management (CRARM 96).

For every billion dollars per year spent on salaries for remediation and construction workers, approximately 20,000 workers will be employed. This is based on the assumption that the fully burdened, average annual salary of the workers is $50,000 per year. DOE statistics (obtained from the World Wide Web, http://www.tis.eh.doe.gov:80/docs/oipds/oipds954/sum954.html) reveals DOE and contractor fatality rates of 1.2 to 6.5 fatalities per 100,000 worker-years from 1986 to 1995.[4] As a point of comparison, the worker risks for heavy construction are about 33 fatalities/year per 10^5 workers (DOL 1993). Hence, for each billion dollars per year invested in construction worker salaries, there may be about 1 to 5 fatalities. These workers will undoubtedly work elsewhere if not on the EM program. However, one of the primary purposes for the EM program is the mitigation of public risk. Hence, at a minimum, the EM activities should eliminate at least as many potential fatalities as they may cause. The RDS MEM scoring system is not able to evaluate these trade-offs.

The point to be made with these statistics is that resources invested in public health and safety can have a return on investment on the order of $100,000 to $1 million per statistical death averted. Accordingly, the value of the EM programs and activities are best judged within the context of the return on investment achieved by other similar programs. In the case of the EM budget, the return on the investment also includes the return of property to productive use, the protection of the environment, and the conservation of cultural resources. As such, the EM budget allocation process should demonstrate that these resources are being managed to achieve the maximum return on investment, taking all the costs and benefits into consideration.

V.C.14. Applicability and Relevance of the MEM to Environmental Restoration

[4] In 1994, there were a total of 12 fatalities experienced during DOE operations. Nine of the fatalities were from an airplane crash and the other three were from a fall from a ladder, a lineman struck by a falling tree limb, and a gun shot wound during training (see the above WWW citation).

Activities.

a. Dual Scoring System

i. Problem

During the FY 1988 budget exercise, the Field Operations were presented with two divergent sets of guidance as regards evaluation of public and worker risk for environmental restoration action. This impaired the cohesiveness of the process, and also the transparency of the process, which is vital to continuing stakeholder participation.

ii. Background

The budget guidance package of November 15, 1995 transmitted and described the Management Evaluation Process, which is based on the use of the Management Evaluation Matrix (MEM). Apparently, because of concerns by the Environmental Restoration (ER) Program (EM-40) that the MEM was devaluing certain ER actions, a different method for scoring public and worker risk, the Relative Ranking Evaluation Framework (RREF), was provided with the second addendum to the budget guidance, dated March 18, 1996. There may be merit in the EM-40 concern as to the MEM in this regard. One cause may be the use of time to impact as a probability measure, when releases have already occurred.

The original ES&H Risk-Based Priority Model (RPM) from which the MEM evolved used a matrix of consequence (or impact) criteria along the Y-axis and probability of occurrence (A,B,C,D elements) across the X-axis. This was perfectly appropriate to the basic definition of risk given as the product of probability of occurrence times consequence, and presumably the scoring values in each matrix cell represent that product. It appears from the RPM literature that the probability of occurrence was intended to apply to the initiating event, e.g., a spill, a roof collapse, etc. It is stated that when an impact already exists with certainty the "A" category should apply. This would appear to apply to any existing environmental contamination situation (on- or off-site) where a release has already occurred. The severity of the impact accounted for considerations of the potential for off-site releases and the potential for deaths, injuries, or exposures of the off-site population.

For a groundwater contaminant plume, for example, one factor going into such severity considerations could be the time to impact on the off-site population. However, as discussed below, the severity considerations for groundwater contamination problems are more complex.

The MEM matrix explicitly places the time-to-impact on the affected population along the X-axis, juxtaposed with the probability of an initiating event. In a "site personnel sense,"

the probability of occurrence of an initiating event and the time-to-impact are essentially the same measure. However, when significant lag times for contaminant transport are present, as is often the case in an environmental restoration context, the two parameters are very different. By placing what is essentially an impact measure along the X-axis, the fundamental risk basis (probability x consequence) of the RPM matrix is distorted. Additionally, by maintaining the time frames that were applicable to deteriorating structures (0-100 years), as opposed to potentially longer time frames for groundwater contaminants to migrate, use of time-to-impact and the matrix could result in groundwater problems being given lower scorings (in the "D" column), and remedial actions potentially deferred. Because of the inherent tendency of groundwater problems to get worse with time (absent decay) and the fact that land use changes appear forthcoming, this outcome may not be in concert with the "responsible stewardship" theme in the National Academy of Science (NAS) report: "Improving the Environment, and Evaluation of DOE's Environmental Management Program," 1995.

iii. Recommendations

1) Restricted Use of Time to Impact as a Criterion: It would appear to be in the DOE corporate interest to come to agreement on one scoring system. The MEM appears to be the preferred method for the time being. Therefore, it could be footnoted to indicate that time to impact should not be used across the A,B,C,D elements when a release has already occurred and significant contaminant transport times are involved. Rather the "A" category should be used and time to impact could be considered, along with other factors, in determining the consequence element to be applied.

2) Groundwater Criteria: In determining consequences, it should be recognized that contaminant concentration and population affected are important factors. Various analytical solutions for groundwater concentrations of a radioactive contaminant indicate that the concentration varies directly with the strength of the source and inversely with the retardation coefficient of the radionuclide, and other factors. The concentration decreases rapidly with radionuclide travel time, provided that the decay rate is rapid compared to the travel time and that dilution occurs with time.

3) Supplemental Guidance: To assist in the severity judgement, the Department should consider developing additional supplemental guidance. Perhaps some elements of the RREF can be extracted and used within the framework of the MEM process without resorting to a separate and distinct scoring method. In addition, it may be necessary to add greater discrimination to the MEM severity criteria, including the extension of the public health and safety and

environmental protection categories to a fourth severity element.

b. Review of Certain MEM Cell Values

The CRESP Tier-2 National Review Panel report and several of the interviews with DOE site operations personnel responsible for the preparation of the RDS's reveal that the MEM scores, especially the Public Safety and Health (PS) scores, were prepared in an inconsistent manner. In addition, some sites, such as the Chicago Operations Office, employed the absolute risk criteria in preparing PS scores, while other sites, such as the Savannah River Operations Office, employed relative risk criteria. During the IRB meeting, it was generally agreed that the information needed to provide an absolute measure of risk was not available. The information for scoring the absolute risks of a specific activity may not be available, but the absolute risk information about the objective of the activity is likely to be available in RI/FS reports, ROD'S, and EISs.

As pointed out in an interview with the Chicago Operations Office, additional guidance is needed on how to go about preparing the PS scores. For example, a PS score of 1 indicates that if the action is not taken (even given the presence of site-wide H&S and S&M programs), immediate or eventual loss of life or permanent disability may be expected. In addition, if the activity is assigned a likelihood of occurrence of "A," such impacts are expected to occur within one year. An "immediate" off-site fatality could occur if a release were to occur such that an individual off-site could receive a whole body radiation dose exceeding about 400 rem. Such an event has never occurred in the U.S. Alternatively, a release that increases the probability that an individual will eventually contract a cancer can be interpreted as a PS of 1. For example, a release that causes an off-site dose of 1 rem may increase the lifetime risk of fatal cancer by about $5x10^{-4}$ (EPA 94). Should this be assigned a PS of 1?

Alternatively, a release that causes a relatively small dose, such as 100 mrem, will impose a marginal increase in the risk of cancer to any one individual. However, if 100,000 people were to receive such a dose, it is possible that about 5 people in the exposed population may eventually develop a fatal cancer as a result of the exposure. Should this scenario receive a PS of 1?

In order to gain greater insight into this important issue, an analysis was performed of selected RDS's that received a PS score of 1A for the "before" category in the MEM. A computerized "sort" was performed on the full set of approximately 1400 RDS's contained in the IRB database. The sort identified all RDS's where a score of 1A was assigned for the PS category, specifically for "before" the activity is implemented. Table V.C.14-1 presents the results of the sort. The check mark next to the listed RDS's identifies those RDS's that were downloaded and reviewed. RDS's were selected from each of the sites, and, for some of the larger sites, more than 1 RDS was selected. A total of 23 RDS's was reviewed. Table

V.C.14-2 summarizes the results of the review.

Inspection of Table V.C.14-2 reveals the following:

i. Sites where the contamination is off-site (such as case 1) are appropriately assigned a likelihood of occurrence of "A." However, it is not immediately apparent that a marginal increase in risk to a large number of individuals, as in case 1, should be assigned a PS of 1, even though, theoretically, the collective dose translates to some additional cancer fatalities in the exposed population. This question applies to Formerly Utilized Sites Remedial Action Program (FUSRAP) and Uranium Mill Tailings Remediation Act (UMTRA) sites where elevated levels of naturally occurring radionuclides are present at vicinity properties. Additional guidance may be needed which includes defining the collective doses that warrant a PS score of 1.

ii. Some RDS's conclude that a PS of 1 is appropriate because of projected increases in the release of radioactivity or hazardous chemicals to the environment, without referring to a quantitative assessment of risk or presenting a quantitative risk which appears to be too small to be a 1A. Examples include cases 2, 7, 8, 9, 13, 15, and 16. Additional guidance may be needed regarding off-site risks and release estimates that may warrant a PS of 1.

iii. Several RDS's (cases 3, 4, 5, 10, 11, 12, 17, 18, 19, and 23) provide for site-wide H&S and S&M programs that are required to control access to the site, and prevent a breakdown of the systems and controls that preclude large releases to the environment. As such, these "min-safe" programs appear to be appropriately scored as a 1A. However, in some cases, only portions of the programs provide min-safe services. Other portions, such as food services and laundry services, which are bundled into this category, have little relevance to min-safe. Consideration should be given to separating min-safe activities and budgets from other landlord functions unrelated to risk.

iv. Several RDS's provide for security for Category I Special Nuclear Material (SNM); i.e. cases 20 and 21. A 1A assignment seems appropriate.

Table V.C.14-1

Table V.C. 14-2 Comparison of Selected RDS's that Received an MEM PS Score of 1A for "Before"

Descriptor	Summary	Discussion of Risks
1. Albuquerque RDS No. R96A0002 EM-40	This RDS addresses the cleanup of soil contaminated with uranium mill tailings at 4000 properties in the vicinity of Grand Junction, Colorado.	In this case, radioactive material is located in the immediate vicinity of private residences. Based on the exposures to the public from external radiation from Ra-226+D and indoor radon, the RDS cites the potential to cause 360 fatalities over 100 years if the soil is not remediated. Extensive documentation is readily available on the costs and benefits of the cleanup of vicinity properties. For example, the Final Environmental Impact Statement (FEIS) for 40 CFR 192 (EPA 520/4-82-013, October 1982) presents a detailed assessment of the public health risks of mill tailings that have been relocated and used as fill and construction material at vicinity properties. The EIS estimates that if the tailings in vicinity properties (700 buildings) are not removed, there will be an additional 70-150 lung cancer fatalities as a result of exposure to indoor radon alone. This assessment is based on linear extrapolation of epidemiological data obtained from uranium miners. An assignment of 1A seems reasonable.
2. Brookhaven National Laboratory RDS No. R96A0009 EM-30	This RDS addresses a broad range of core activities needed to support the management of hazardous and radioactive waste at the lab. The activities include training, H&S, and planning.	Without being quantitative or referring to supporting documentation, the RDS indicates that, without funding for these activities, the potential exists for the release of radioactive material to the environment, which could result in an increase risk of cancer off-site. Such releases would have to be substantial and not controllable by their site-wide H&S and S&M programs to cause individual and collective doses that could result in cancer fatalities. Without documentation, it is difficult to determine if a score of 1A is reasonable.

3. Chicago Operations Office RDS No. R96W0008 EM-70	This RDS addresses funding for 49 full-time equivalent personnel responsible for oversight of EM activities.	The RDS indicates that a score of 1A was assigned based on the highest score of any of the Chicago Operations RDS's. The idea being that without funding for personnel to oversee the program, none of the activities will be implemented. This approach begs the question whether any of the RDS's are appropriately scored as a 1A (see the next RDS review). Note that the results of the interview with a representative of the Chicago Operations Office revealed that in his opinion, none of the RDS's should have received a score of 1A or 1B. In addition, it also begs the question whether this RDS should presume that site-wide H&S and S&M activities are in effect. To a degree, this RDS provides the funding for the site-wide H&S and S&M activities, a somewhat paradoxical set of conditions.
4. Chicago Operations Office RDS No. R96W0009 EM-70	This RDS addresses D&D activities, remedial actions, waste operations, and technology development. It appears to be similar to RDS No. R960008.	See the writeup for RDS No. R960008. It would appear that none of the Chicago Operations Office RDS's were scored 1A, except the funding for EM personnel salaries. Hence, there appears to be no risk basis for the assignment of 1A to this and the previous RDS.

5. Ohio Operations Office RDS No. R96A0013 EM-40	This RDS provides funding for site-wide landlord services, infrastructure control, H&S and S&M for Fernald.	The RDS refers to several reports that demonstrate that without institutional control over the site, there is a 100% chance of increased cancer fatalities for members of the public who may gain access to the site. With institutional controls, there is a 10^{-3} chance of an increased cancer fatality for the public. This is another case where it is not possible to score this activity if it is assumed, as the RDS guidance states, that site-wide H&S and S&M programs are in place, since this RDS addresses these site-wide activities. (It would appear that some re-engineering of the RDS's is needed, since funding for these site-wide activities is first provided and not included in the RDS scoring, and then the RDS scoring is applied to the other activities, while assuming that the site-wide activity is in place.)
6. Hanford Operations Office RDS No. R95C0008 EM-60	This RDS provides funding for the waste Encapsulation and Storage Facility (WESF) for the FY 1996 capsule return program. This facility is used to encapsulate and store in water filled pools 73 million Curies of Cs-137 and Sr-90. The facility was built in 1974 and must be maintained. The encapsulation service is provided as the need arises. This budget specifically addresses 15 defective cesium capsules returned to Hanford for re-encapsulation.	If S&M of the facility is not maintained there could be a loss of pool water and failure of the capsules in storage due to overheating. This could result in the release of thousands of Curies of Cs-137 and Sr-90 to the environment, and the acute exposure of individuals off-site to very large radiation doses. References to risk assessments supporting these conclusions is not provided. However, given the large inventories, it is not unreasonable to assume that serious off-site impacts are plausible if coolant is lost. However, the recurring question regarding min-safe as a prerequisite arises again. If site-wide H&S and S&M are in place, is it plausible to assume that loss of coolant and failure of the capsules would occur. It seems more likely that, given min-safe, such a scenario is unlikely.

7. Hanford Operations Office RDS No. R95T0005 EM-60	This RDS addresses S&M of a building housing the FFTF fuel fabrication facility. It also addresses the disposition of metallic sodium, and disassembly of piping and support systems.	The RDS refers to documentation and explains that assuming S&M is in place, but deactivation of the facility is not funded, the alkali metal and systems will remain in place. They postulate that if one of the pipes are inadvertently cut, a leak will occur which will cause a sodium fire, and toxic, but not radioactive, aerosols would be generated. The event will be detected by sensors that would automatically isolate the building ventilation system, thereby precluding 90% of the releases to the environment. The RDS explains that if the system is deactivated, this scenario would not occur. The RDS explains that if such an accident were to occur, the NaOH airborne vapor concentration at the site boundary would be about 15 mg/m3. The TLV is 2 mg/m3, the IDLH is 40 mg/m3, and 250 mg/m3 could be fatal. On this basis, there are many reasons why a 1A score seems inappropriate. First, assuming S&M in place, the likelihood of the described event is reduced (it is difficult to believe that there is a high likelihood that such an event would occur in one year, as an "A" score would indicate). In addition, even if such an accident were to occur, the consequences of 15 mg/m3 would be limited to irritated eyes, well below the potentially lethal level. Without S&M, and assuming the accident occurs, it is possible the isolation system will not be effective, and the airborne concentrations off-site could be about 10 times higher, or 150 mg/m3. This begins to approach the level where serious injury is possible.

8. Hanford Operations Office RDS No. R95T0006 EM-60	This RDS addresses the deactivation of the Fast Flux Test Facility (FFTF). Large amounts of radionuclides and sodium are stored in the facility. If not deactivated, the potential exists for a fire and release of radionuclides and sodium hydroxide to the environment.	A 1A was assigned based on the possibility that there would be a fire and that an off-site dose of 0.39 mrem and 31 person rem would occur. The RDS states that this corresponds to .016 fatalities. The sodium hydroxide levels are estimated in the RDS to be below dangerous levels. Given this analysis it difficult to understand why a 1A was assigned to public risk.
9. Hanford Operations Office RDS No. R95T0008 EM-60	This RDS addresses the deactivation of the 309 Building/Plutonium Recycle test Reactor (PRTR). Large amounts of radionuclides and hazardous chemicals are inventoried in at the facility. If not deactivated, the potential exists for a fire and release of radionuclides and hazardous chemicals to the environment.	A quantitative analysis of the off-site impacts is not provided. However, given the size of the Hanford site, it is difficult to believe that the impacts would be immediately fatal off-site. In addition, since a fire or other event must be postulated to occur with no intervention, it is difficult to understand why an "A" was assigned to frequency or probability of occurrence.

10. Hanford Operations Office RDS No. R96N0027 EM-30	It appears that this RDS supports the site-wide min-safe operation (this begs the question whether the S&M program funded under the above RDS is funded by this program). The RDS also includes analytical lab maintenance in support of cleanup, which is considered beyond the scope of min-safe, but it does not include the actual analysis of samples. (It appears that the scope of each RDS should be limited to discrete activates and not clusters of activities. By clustering activities in this way, some activities may be "carried" by others; i.e., the line item veto issue).	The RDS score of 1A is driven by the need to maintain min-safe. It seems that many of the lab related activities are carried by the min-safe component of this RDS. Without min-safe, which could result in uncontrolled occupancy of the site, it is not unreasonable to assume that some fatalities would occur. However, other parts of the RDS indicate that the min-safe aspect of this RDS only applies to maintaining the analytical lab. The RDS explains that if min-safe for the lab is not maintained, contamination could be spread off-site. Alternatively, if the analytical lab is not maintained, the RDS explains that samples would have to be shipped off-site, which poses increased transportation risks. The concern over the possible spread of contamination and transportation accidents related to the analytical lab does not appear to justify a 1A score. However, site-wide min-safe, in its broadest application, would seem to justify a 1A score. The RDS is confusing with regard to its intent and scope.
11. Hanford Operations Office RDS No. R96N0192 EM- not given	This RDS supports site-wide fire suppression oversight, rescue services, and hazmat response.	The RDS explains that an uncontrolled fire in some of the Hanford facilities could result in fatalities off-site due to large releases. Documentation for this conclusion is not provided. However, a 1A score does not appear to be unreasonable.

12. Hanford Operations Office RDS No. R96N0202 EM- not given	This RDS supports site-wide motor vehicle and pedestrian safety.	The RDS explains that, without traffic controls, the accident rate for the 14,000 employees and the 5000 employees that commute to and from work from the outer area roads would experience a higher accident fatality rate. A 1A score seems to be reasonable (i.e., the activity is part of landlord functions that provide min-safe.)
13. INEL Operations Office RDS No. R96D01265 EM-50	This RDS supports a research program to fill gaps in our knowledge to choose among alternative methods for stabilizing Pu residues in process lines. The program is called the Pu Focus Area and was developed in response to DNFSB Recommendation 94-1. The program, which is funded by this RDS, identifies and evaluates R&D programs for stabilizing the Pu residues.	The RDS explains that, if the Pu residue problem is not corrected, there could be significant Pu releases, including criticalities. It appears that there is no doubt that some action is needed to correct this problem. However, it is not apparent that the problem cannot be managed without R&D and that immediate off-site fatalities would occur if this research is not supported.
14. Oak Ridge operations Office K-25 RDS No. R96S0018 EM- not given	This RDS supports all H&S and S&M activities under DOE Order 5480.1B for K-25. It also addresses special training programs for enhancing site safety, and safety awards programs.	The implication is that, without the site-wide H&S program, there could be immediate off-site fatalities. This may be the case, however, no documentation is provided that the consequences of not funding this program would be so severe and so immediate. In addition, the special training program and the awards program are probably being "carried" by the site-wide program.

15. Lawrence Livermore National Laboratory RDS No. R96A0003 EM-40	The general Service Area is an operable unit on the NPL. Undetermined quantities of TCE and other VOCs have been released to the ground at this site and the groundwater is contaminated with TCE to a level 240 ppm. This RDS supports pump and treat for groundwater and soil remediation programs that fulfill CERCLA requirements.	The RDS refers to baseline risk assessments that result in unacceptable risks to the public. However, according to EPA CERCLA guidelines, a risk in excess of 10^{-4} is unacceptable. The RDS refers to off-site lifetime cancer risks from drinking the contaminated groundwater of 10^{-3}. However, such a risk does not represent an imminent hazard, as defined in the RDS guidance for a 1A risk category. In addition, the risk can be avoided by providing alternative sources of drinking water. This is certainly a problem, but not a 1A problem.
16. Lawrence Livermore National Laboratory RDS No. R96A0010 EM-40	This RDS is similar to the previous RDS except it deals with off-site groundwater supply wells that are currently not contaminated with TCE. But there is priority-setting groundwater contamination in the regional aquifer that is moving off-site. A potential exists for off-site risks from groundwater contamination on the order of 10^{-3}.	A 1A was assigned because of the increased risk. However, it is questionable whether a 10^{-3} increase in individual risk warrants a 1A score. If thousands of people are at risk, it may make sense. However, interdiction will likely preclude such exposures from occurring. In addition, it is not apparent that such exposures would occur within one year, as would be indicated by an "A" score for likelihood of occurrence.

17. Ohio Operations Office Mound Facility R96W0016 EM-70	This RDS is one of 9 RDS's that support site-wide H&S and S&M programs.	The RDS explains that, if not funded, the security of the site would be jeopardized and individuals may gain access to the site. In addition, large releases of radionuclides and hazardous chemicals can occur. Though the RDS does not reference any documentation for these conclusions, the conclusions seem plausible.
18. Rocky Flats Operations Office RDS No. R96A0050 EM-40	This RDS supports the site infrastructure, including O&M, utilities, SNM safeguards, emergency services, fire protection, food and laundry services.	The RDS explains that the infrastructure services are needed to ensure the containment of tons of plutonium. However, all of the activities under this RDS do not play such a critical role, such as food and laundry services. Certainly, safeguarding the plutonium inventory is essential. This raises a fundamental question whether it is possible or necessary to separate the essential from the non essential services in the RDS's.
19. Savannah River Operations Office RDS R96B0002 EM-70	This RDS supports site-wide fire protection services.	The RDS explains that this RDS is needed to preclude large catastrophic fires at the site, which can result in large radionuclide releases to the environment. A score of 1A seems appropriate.
20. Savannah River Operations Office RDS R96C0001 EM-60	This RDS supports security of the K-Reactor which contains Category I Special Nuclear Material (SNM)	It would appear reasonable that safeguarding SNM should be assigned a 1A given the potential consequences associated with SNM in the wrong hands.
21. Savannah River Operations Office RDS R96C0003 EM-60	This RDS supports security of the FB-Line which contains Category I Special Nuclear Material (SNM).	It would appear reasonable that safeguarding SNM should be assigned a 1A given the potential consequences associated with SNM in the wrong hands.

22. Savannah River Operations Office RDS R96D0002 EM-70	This RDS supports the Savannah River Ecology Lab.	The RDS states that a 1A is assigned because without the Labs research, there would be more vehicular accidents with the deer population at the site. It is difficult to accept this argument for assigning a 1A. in effect, this RDS is given the same public safety score as safeguarding Category I SNM.
23. Ohio Operations Office West Valley Project Office RDS No. R96C0004 EM-30	This RDS supports essential site operations for West Valley.	The RDS explains that, without essential site services, failure of the HLW tanks would be imminent. A total of 24 million Curies would be available for release to the groundwater, and spent fuel in the spent fuel pool would be left uncontrolled. Though a risk assessment is not provided, the score does not seem unreasonable.

V.C.15. Reduction of the Number of Ranking Lists

a. Problem

Compliance, mission impact, mortgage reduction, and stakeholder concerns (and others) are appropriate considerations on which to rank projects. However, this can be done without scoring each project on each impact category and preparing separate priority lists for these categories.

b. Background

The 1995 NAS report cited above stated that some measure of risk or risk reduction is likely to be a primary factor in prioritization, but also acknowledges that beyond the prompt addressing of serious and imminent risks, risk becomes one of several factors to consider in an overall cost/benefit analysis, which should form the basis for further prioritization (See page 11, Part I: Synthesis Report). The MEM, in apparent recognition of these other factors, has included several value categories beyond the "true" risk categories of public health, worker safety, and environmental protection.

Several questions arise regarding addressing this balancing through the matrix. (1) Is it necessary to prepare ranking lists for categories like compliance when many activities in that list may not face a compliance issue? (2) Are the A,B,C,D probability designations relevant to these non-true risk impact categories?

c. Recommendations

i. Number of Lists: Regarding the number of lists (question 1 above), it may be desirable to prepare only three ranking lists. The first list would be based on an amalgamation of the three "true" risk impact categories (public health, site personnel safety, and environmental protection). The second, the optimized list, would result from a re-ranking of the first risk list based on the other impact categories. The third list is new. It would reorder the second based on the value-to-cost ratio of the project (see section V.C.18).

   The Department should consider presenting the first two lists side by side with a "comment" column to the right of the optimized list. Whenever the optimized rank of a project differs significantly from the risk rank, amplify the reasoning; e.g., "high mortgage reduction opportunity, return on investment of 35%" in the comment column. This creates a transparent rationale for the mapping from the first list into the second optimized list, and would be of great use in dialogue with stakeholders and others.

ii. Matrix Restructure: It does not appear that A,B,C,D probability designations are particularly relevant to the mission impact, stakeholder, and mortgage reduction categories. Therefore, the MEM matrix can be restructured into a basic

"risk" matrix (public, worker, environment) which still uses the A, B, C, D designations and another matrix (or matrices) using other criteria besides probability that are customized to the "value" category. The emphasis or weight afforded to the value categories outside the first "risk" matrix should be regarded as dynamic, i.e., subject to change from year to year, based on HQ and field office policy priorities, and the emphasis or weight for the first "risk" matrix should be fairly stable. This separation also supports the preparation of a risk list followed directly by an optimized list as proposed above, in recommendation i.

V.C.16. Enhancement of the Transparency of the Process for Developing the "Optimized" Ranking List

Given that activities/objectives can be scored in a consistent manner (i.e., the "front end" of the budget allocation process), the process of going from the RDS's to the optimized priority list and then to the final budget allocation (i.e., the "back end" of the process) needs to be fully disclosed and justified. As much attention needs to be given to the back end of the process as is being given to the front end of the process. This section discusses the back end of the budget allocation process and strategies for making the process more transparent. The material upon which this discussion is based includes the minutes and handouts of the EM Internal Budget Review (IRB) meeting held by DOE in the Forrestal Building from May 20 to 24, 1996, and the minutes of telephone interviews with site operations office personnel involved in the RDS scoring process.

Prior to the IRB meeting, each site office prepared a budget for FY 1998 using an assigned budget, referred to as "the planning level." Each site representative presented the sites planning level budget broken down by activity. The activities were prioritized and include the RDS scores so that the relationship between the RDS scores and the assigned priority is apparent. This material is contained in the budget request support packages delivered to DOE headquarters by each Site Operations Office on April 15th. Each site representative then justified the assigned priority to the participants at the IRB meeting. In general, the assigned priorities consider the judgement of DOE site managers and their contractors, the regulators, and the stakeholders.

Table V.C.15-1, which was assembled from the April 15th submittal for one of DOE's Operations Offices, presents the optimized priority list for the first 20 RDS's, along with the priority of each activity with respect to selected MEM criteria. Each presenter at the IRB meeting was requested to provide information in this form so that EM management and all IRB participants could assess the trade-offs made in constructing the optimized priority list. This step in the budget allocation process reveals that the Department is interested in disclosing these trade-offs. However, with the exception of a limited number of questions and

answers during the IRB presentations, there is no written material explaining, on an item by item basis, the rationale for the final optimized priority list.

Based on interviews with selected site representatives and a review of the MEM guidance, it appears that the optimized priority list is based on the collective judgement of all participants and was prepared, at least in draft form, prior to RDS scoring. As such, the RDS scoring process did not have a significant influence on the prioritized list. The comparison of the prioritized list with the priorities based on the individual MEM scores for ES&H, Compliance, Mortgage Reduction, and Socio-Cultural criteria is provided to disclose the relationship, but not necessarily influence the final priorities.

Inspection of the April 15th submittals reveals that the public health and safety, worker risk, and environmental impacts scores were combined into a single parameter referred to as "ES&H." The fact that a combined score is used for the purpose of disclosing these relationships provides insight into the level of precision and discrimination that the process hopes to achieve. It appears that the ES&H assigned priority is based on a general sensibility regarding the importance of the activity with respect to public, worker, and environmental impacts. The reliability of the score based primarily on professional judgement is questionable, especially given the ambiguity created by the min-safe issue and the lack of quantitative risk assessments for the public. Hence, until a more reliable and consistent method is developed and applied for scoring the components that comprise ES&H, these comparisons have limited use.

Notwithstanding the consistency issue, Table V.C.15-1 also reveals some surprising comparisons. First, it is surprising to note that none of the top ten activities in the optimized priority list are among the top ten priorities based on ES&H, Compliance, Mortgage Reduction, or Socio-Cultural criteria. In addition, only six of the RDS's in the top 20 in the optimized priority list were assigned a score of 20 or lower for any of the 4 MEM criteria. These results beg the question: what criteria were used to assign the indicated activities such a high priority? In general, the rationale for the optimized priority list is not provided.
It is also noteworthy that the DOE FTE and support budget for managing the site is inserted into the list as the highest priority, even though they received the lowest priority for the individual MEM scores. If the DOE site management budget is thought of as part of min-safe, assigning a high priority to the management budget seems to be reasonable. In effect, by placing min-safe type activities at the top of the priority list, there is assurance that the activities will be funded. However, min-safe type programs, such as management budgets, and site-wide infrastructure, S&M, and security support, may be more appropriately defined and justified in a process separate from the scoring of individual activities and programs.

This discussion thus far has focused on the development of the optimized priority list by site operations personnel for delivery to Headquarters in support of the IRB meeting. As

explained at the IRB meeting, this information is intended to "inform Headquarters" and, thereby, help Headquarters prepare and support their budget request to OMB. Ultimately, the success of Headquarters in competing for Federal dollars will depend on the strength of their arguments regarding the need for the various programs and activities and the reliability of the cost estimates to achieve the various program objectives. A great deal of effort went into the development of the RDS's, the optimized priority lists, and the associated budget. The question becomes, does the MEP process provide compelling arguments for the large EM investment and the allocation of the budget among programs, sites, and activities? Unfortunately, without an attempt to quantify and document the costs and the benefits, and the overall value to society of the investment, decisions regarding the size and allocation of the budget will likely be based on considerations other than sound public safety and environmental economic investment principles.

Table V.C.15-1. Example of the Relationship Between the Optimized Priority List and Selected MEM Rankings (The Back End of the Prioritization Process) for a DOE Operations Office

RDS Order of Optimized Priority (241 RDS's)	*ES&H Assigned Priority*	*Compliance Assigned Priority*	*Mortgage Reduction Assigned priority*	*Sociocultural Assigned Priority*
1. Program Direction FTEs	240	240	238	240
2. Program Direction Support services	241	241	239	241
3. WM Program management	43	68	177	35
4. Radioactive liquid waste treatment	42	67	32	33
5. Radioactive liquid waste disposal	96	220	33	34
6. Hazardous waste storage	40	62	29	179
7. Hazardous waste disposal	149	63	30	180

RDS Order of Optimized Priority (241 RDS's)	*ES&H Assigned Priority*	*Compliance Assigned Priority*	*Mortgage Reduction Assigned priority*	*Sociocultural Assigned Priority*
8. RCRA permit renewal	45	79	182	38
9. LLMW storage	41	64	86	95
10. LLMW treatment	12	65	78	181
11. LLMW disposal	13	66	31	182
12. LLW disposal	94	187	27	93
13. LLMW toxic substances control act storage	150	72	145	183
14. Mixed TRU waste storage	?	60	26	91
15. Mixed TRU waste disposal	98	71	88	97
16. WM program management	28	23	8	2
17.Characterization/S&A /data validation	30	25	56	63
18. Non-radioactive waste TDS	33	31	15	16
19. Mixed LLW storage	32	30	14	15
20. Mixed LLW treatment and disposal	36	15	21	21

V.C.17. Improvements to Facilitate Cross-Site Budget Reallocation Decisions

a. Problem

Because of differing approaches by various sites in defining the project scope of the RDS, and in the methods of ranking the optimized list, it would have been difficult to apply the RDS process this year to cross-site funding reallocations. However, the DOE may choose to refine the process to have that capability in the future.

b. Background

As pointed out in the NAS report (NAS, 1995), it is often the major purpose of a priority ranking system to determine what not to do, as opposed to what to do. In that vein the essence of an across-site method would be to compare in a systematic way those few projects from each site that are around the target funding level for each site.

c. Recommendations

To accomplish this, several actions must be implemented.

First, the scope of the RDS's should be more consistent by aggregating up to the level of a specific programmatic objective (see sections V.B.1 and V.B.2).

Second, greater consistency of H, M, L scoring across sites needs to be achieved (see section V.C.20).

Finally, a common ranking scheme needs to be employed by all field offices for this purpose. This can be accomplished by using the value-to-cost ratio ranking recommended in section V.C.18. The value-to-cost ratios for field operation objectives near (above and below) their respective target levels would be compared. Program objectives within target level at a particular field office with low or very low value-to-cost ratios would give way to objectives at another office above its target level that have better value-to-cost ratios.

The use of the value-to-cost method in the above way fosters strong adherence to cost controls and well-defined allocations of activities (and their costs) to the proper specific program objective. Inclusion of unnecessary activities in an objective will decrease the value-to-cost ratio, jeopardizing funding for the entire objective. Including valuable objectives in high cost objectives, on the expectation that the high cost objectives will receive funding, can leave a dearth of "valuable" objectives at the target level where money transfers will be determined. Finally, by using multi-year cost in the value-to-cost ratio, and measuring value from objective beginning to end (see section V.B.2), inconsistent comparisons based on

annual value-to-cost ratios are avoided.

V.C.18. Consideration of "Value-to-Cost" Relationships in Project Ranking

a. Problem

The endpoint of the current ranking process is essentially an ordered listing of projects based on the most important "values" (risk, compliance, mortgage reduction, etc.) of the DOE organization. In the IRB meeting presentations FY 1998 annual project costs were generally presented with the project ranking lists, but it does not appear that actual project cost itself was used as a ranking factor. In addition, multi-year project costs were not presented or discussed.

b. Background

The DOE predicament revolves around having many more projects it wants to pursue than each year's funding allows. Therefore, it seems that the ultimate objective of a scoring and ranking system for DOE's use should be to assist in maximizing the pursuit of its "values" -- such as risk reduction under a cost constraint -- not just to rank its projects based on those values. To do this the ratio of the project's "value" scoring to its cost must be considered. If a way can be found to take the qualitative project value scores that emerge now, and convert them into qualitative effectiveness/cost ratios, then a third and final ranking could readily be done on the basis of effectiveness divided by cost. Maximizing that ratio in an overall DOE sense is the objective. This becomes especially important for the 10-year plan where the Department seeks to achieve specific objectives within a specified time frame.

c. Recommendations

Criteria should be set up to score multi-year project costs as, for example, "High," "Moderate," or "Low". These scores could be based on a "cost" matrix (to be developed that considers both the numeric cost and the uncertainty in the estimate and other factors). An additional matrix should be created to map the qualitative project "value" scores that are already being developed through the MEM (or variants thereof) and the qualitative cost scores derived above, into their quotient, i.e., project value divided by cost. This mapping matrix might look something like that below:

Value/Cost Scoring Matrix

	Project Value (based on MEM)		
PROJECT COST	**H**	**M**	**L**
HIGH (H)	**M**	**L**	**VERY LOW**
MODERATE (M)	**H**	**M**	**L**
LOW (L)	**VERY HIGH**	**H**	**M**

Based on the above matrix, or a variant, projects would be ranked based on their value/cost score. The ranking would be used to defer those projects with low or very low value/cost ratios in favor of those with better ratios. It could be used at two points within the process: first in evaluating alternatives to meeting a specific program objective (section V.B.4), and second to order the field office projects for purposes of across-site reallocation decisions (section V.C.17).

When establishing a value-to-cost ratio, it must be remembered that the "value" is not risk per se, but reduction of the overall risk, cost, and impact profile. Thus the DOE system needs to come to grips with what, for example, a "High" score minus a "Low" means. Some guidance in this regard may be found in the original matrix of the Risk-Based Priority Model where H, M, and L scores (numerically) represented order of magnitude differences, e.g., a "High" was valued at ten times a "Moderate" score. If that truly reflects the DOE valuation of a “High” vs. “Moderate” score then the subtraction of a “Moderate” or “Low after” score from a “High before” score would still be represented fairly well by a “High” risk reduction. On the other hand, if a “High” only represents twice a “Moderate”, then some other system of subtraction will have to be developed. This may be an issue for a DOE/stakeholders team to grapple with.

When using a value-to-cost approach, the situation may be encountered in which, for example, projects of moderate risk-reduction value may deserve to be ranked above one or more projects of higher risk-reduction value if, taken together, the former yield a greater reduction of risk, and at a lower overall cost, than the latter. The frequency with which such situations may be encountered will depend on the relative costs of the different projects, as well as on the differences EM places on their relative “values.”

Some care in the use of this ranking must be exercised. Certain critical high-risk projects may be expensive, and although their value/cost ratios may not look too favorable, because of the limited discrimination in the risk matrix and cost matrix, they will need to proceed. Nevertheless, used appropriately and consistently across the DOE within each field office, and potentially for cross-site funding decisions, the consideration of a value-to-cost ratio ranking would drive the system each year toward the desired overall maximum realization of its values under the cost constraints imposed.

It should also be noted that the use of the value/cost ratio as a major ranking criteria creates a strong incentive for managers to bolster project rankings by lowering costs. This may, in turn, foster harder looks at emerging technological solutions (see section V.C.12), and other cost-saving measures.

V.C.19. Enhancement of Consistency in the Scoring of High (H), Medium (M), and Low(L) Risks

Inspection of Table V.C.14-1 reveals that, in cases where a given activity precludes the release of hazardous substances to the environment, it is difficult to score the activity with respect to public risk (i.e., PS) without the benefit of a quantitative risk assessment and more specific guidance regarding what constitutes a PS score of 1, 2, or 3. Specifically, it is not apparent that BNL R96A0009, Hanford R95T0005, 0006, and 0008, and LLNL R96A003 should have been scored a 1A for public safety. Hence, except for "min-safe" activities, a quantitative assessment of risk may be needed to implement a risk based prioritization system that allows intercomparisons among sites. "Min-safe" activities are given special consideration (i.e., they don't need a quantitative risk assessment) because it is apparent (again see Table V.C.14-1) that, without site-wide H&S and S&M programs, access to the site would be uncontrolled and essential systems and services would be lost, thereby creating the potential for large releases to the environment.

Assuming that the Department determines that a quantitative assessment of risks is needed to score public safety, there will be several major challenges to accomplishing this objective, including:

a. Definition of Min-safe

Assumptions regarding min-safe can have a profound effect on the potential for a given activity to have significant off-site impacts. Specifically, if min-safe is limited to site-wide S&M programs (i.e., maintaining the site infrastructure and security and performing environmental surveillance programs), the potential for a significant off-site exposure is reduced but probably not eliminated. If min-safe includes S&M for specific buildings and

facilities, the potential for significant off-site impacts from that building or facility is further reduced, if not eliminated.

It is suggested that min-safe assumptions be limited to well defined, site-wide infrastructure and S&M activities and security, and not include specific S&M programs for specific facilities. This definition of min-safe will help to achieve a more consistent score for public health and safety because it precludes the need to make highly subjective judgements regarding the extent of facility specific S&M which should be assumed for the purpose of scoring. In addition, the costs and consequences of S&M for specific facilities and activities are appropriately included in the evaluation of the activity.

b. Performance of Quantitative Risk Assessments in a Consistent Manner

As evidenced in V.C.14, some RDS's are supported by off-site quantitative risk assessments and many are not. The data also reveals that it may not be possible to intercompare the public risks of activities within and among sites without a supporting quantitative assessment of risks. The challenge associated with such assessments are that they could become costly and time consuming, and in the end remain inconsistent because of the use of inconsistent risk assessment methodologies and assumptions. Nevertheless, the current system clearly is not working well with respect to scoring public safety and health.

In our opinion, there is no reason why relatively simple, order of magnitude assessments of risk cannot be performed, once the activity and its objectives and min-safe are clearly defined. In many cases, the risk assessments provided in NEPA and CERCLA documentation can be used directly or used with minor revision. Alternatively, once a reasonable estimate of the source term is defined, simple screening models, such as those described in NCRP Report No. 123 (NCRP, 1996), can be applied. Simple hand calculations are good enough for the purpose of the MEP. The outcome could be an assessment of the potential high-end exposures to individuals at the closest off-site receptor locations (now and in the future) and the collective exposures, for both radionuclides and hazardous chemicals. These exposures can be converted to risk estimates using EPA slope factors.

These simple approaches can be used whether the activity is associated with a chronic release problem, such as many of the ER program activities, or potential acute exposure problems, such as many of the DNFSB 94-1 defined issues. For the chronic release problems, the exposures can be presented on an annual basis. For the acute release problems, one-time exposures can be presented. The current MEP system for scoring likelihood of occurrence is well conceived and can be explicitly incorporated into the assessment.

c. The Development of More Specific Scoring Criteria

The MEP guidance provides many examples of how to go about assigning MEM scores for public safety. However, there still appears to be some confusion regarding how to assign scores for public safety. For example, if the off-site risk to the high-end exposed individual is 10 rems (a very high exposure from a regulatory perspective; i.e., 100 mrem/yr is the current radiation protection standard), should a PS score of 1 be assigned? Since this one-time exposure is 100 times above the annual exposure limits for protection of the public, it would not be unreasonable to assign a PS of 1 for public risk. However, 10 rem will have no immediate significant adverse health effect on the exposed individual, and the additional lifetime risk of fatal cancer from 10 rem is about 5E-3. Using the current definition of PS values, including the examples provided in the MEP guidance, it is not immediately obvious whether the score should be 1, 2, or 3.

Let us assume that a quantitative risk assessment reveals that a given event can cause a one-time collective exposure of 10,000 person rem to 1 million people (i.e., an average of 10 mrem/person), but no one individual receives more than 1 rem. Using conventional methodologies, 10,000 person rem potentially can result in 5 additional cancer fatalities in the exposed population. This would appear to warrant a PS score of 1. However, when it is recognized that those same 1 million people will be exposed to about 100,000 person rem per year for their entire lives from natural background (not including indoor radon), and that there is no evidence of an increase in health risk from high end natural background exposures, it is certainly debatable whether a PS score of 1 is warranted.

There are many other exposure scenarios, for both acute and chronic exposures to both radionuclides and hazardous chemicals (for both carcinogenic and toxic chemicals) that can be constructed and discussed. Before a fully consistent scoring system can be implemented, these questions regarding scoring must be resolved.

d. Providing Sufficient Discriminatory Power

The Savannah River Operations Office found that the RDS system results in the assignment of the same score to many activities because the MEM did not provide for adequate discrimination among activities. One strategy for resolving this issue is, after completing the scoring in a consistent manner, the spread of the scores by category should be charted. Clustering over a narrow region of scoring categories would indicate where the system is not adequately discriminatory, and where revision of the system may be needed.

In addition to clustering analyses, consideration is needed in many other important aspects of public risk. Specifically, the potential impacts on the public from various activities (or not performing various activities) can be categorized into the following multi-dimensional matrix:

i. Magnitude of exposure to individuals off-site with the potential to receive high-end exposures.

For example, a high (H) risk could be defined as an exposure which results in an additional cancer fatality risk of 10^{-2} or greater, or a dose high enough to have an acute radiation effect. An acute dose of 50 rem could represent such a risk. A medium (M) risk could be one which results in an exposure between the high risk and the current public health standards. This is a more complicated problem because of the need to deal with one-time acute and chronic exposures. In addition, there is a suite of standards that could be applied, ranging from 4 mrem/year to 100 mrem/year for chronic exposures and up to 500 mrem for a one-time exposure. Alternatively, the M score could be simply based on a lifetime fatality risk which is less than 10^{-2} but greater than the current CERCLA guide of 10^{-4}. A low risk could be defined as an exposure that is below the public health protection standards, or, alternatively, below the 10^{-4} CERCLA criteria.

ii. Magnitude of collective exposures to populations.

In a similar manner, an H could be assigned if the collective exposures could cause ten or more fatalities in the exposed population. An L could be assigned for collective exposures that could cause less than one statistical fatality. An M score could be an exposure that could result in one to ten statistical fatalities.

These numerical values of individual and collective risk are not being recommended as the criteria for use in assigning PS scores. They are used as examples for demonstrating the concept.

iii. Likelihood of exposure.

Likelihood of exposure could be directly factored into the analysis by multiplying t h e individual and collective impacts by the probability that the impact will eventually occur.

iv. Time when exposure begins.

If the exposure is expected to occur but not begin for many years, the exposure could be discounted (as is currently recommended by OMB), or not discounted (as is currently EPA's position).

v. Potential for intervention (yes vs. no).

Many exposure scenarios, though potentially significant, may be markedly reduced or eliminated through intervention. However, some exposures, such as large acute airborne releases (e.g., HLW tank explosion) or acute direct releases to waterways (e.g., failure of the West Valley HLW tanks) may have limited opportunity for intervention.

The current system of assigning a PS score of 1, 2, or 3 and for assigning time or likelihood of exposure does not appear to provide adequate discriminatory power with regard to these important characteristics of a given potential off-site impact. If a quantitative assessment of public risk is considered as a means for improving the PS scoring process, sufficient information should be generated to allow a more powerful discrimination of risk with respect to these characteristics.

VI. RESPONSIVENESS OF THE PROCESS TO THE RECOMMENDATIONS OF THE ENVIRONMENTAL MANAGEMENT ADVISORY BOARD (EMAB)

To a reasonable extent, the FY 1998 budget guidance -- in its several parts -- was responsive to the EMAB recommendations. The guidance (November 15, 1995 Office of Environmental Management, Guidance for FY 1998 Budget Formulation) was not totally responsive, as explained below. Furthermore, the actual work product was much less responsive, for reasons discussed at the end of this section.

The preliminary conclusion of EMAB was expressed in a letter of 29 December 1995 from co-chairs Costle and Alm to then Assistant Secretary Grumbly that commends EM "for its responsiveness as the [EMAB] Budget Committee developed [a list of suggested actions]." This was in response to a 13 December 1995 letter from Assistant Secretary Grumbly to Budget Committee chair Alm in which Grumbly included a short document "Implementing the Environmental Management Advisory Board's Recommendations on Risk and the Budget." This document repeated many of the EMAB recommendations, using EMAB language, on "Improving Data Credibility and Quality," "Land Use," "Integration," "Improving Stakeholder Involvement," "Activity Categorization," "Improving Peer Review," "Timing Issues," and "Budget Case Evaluations." Some of these points were transmitted to a wider DOE audience in the "Project Management Prioritization Guide," February 1995, from the DOE Office of Field Management.

The EMAB recommended development of four separate budget cases: risk reduction, compliance, mortgage reduction, and optimization (29 December 1995). The budget guidance did ask for priority lists for each of these cases, with a "final, optimized list which reflects each Operations Office's formal budget request for FY 1998" (11/15/95 Budget Guidance) but did not ask for separate budgets. The addendum guidance issued on 1

February 1996 did not change the November guidance on this issue.

The EMAB recommended explicit stakeholder involvement in the budget development process (29 December) and the response by Grumbly indicated this would be done. The 15 November 1995 FY 1998 budget guidance states (p.17): "...it is imperative that priority lists, ADS's and RDS's are created with input from the Department's stakeholders..." However, as demonstrated in the 26 March 1996 recommendations of the Oak Ridge Reservation Environmental Management Site Specific Advisory Board[1] and telephone interviews conducted by the CRESP peer review panel of preparers of the RDS's, the involvement of stakeholders has been uneven and often occurs after the process is well underway.

The EMAB recommended peer review of the process in a three-tiered approach (29 December): the first tier by a central group of experts, stakeholders, and regulators, to develop the guidance for the comparative risk assessment process; the second by risk assessment professionals, environmental experts, former and present DOE employees who would conduct the risk assessment; and the third tier by an independent review group. This recommendation is described explicitly in the field office guide. However, the implementation has been limited at best, in that the first step was done by DOE with, as just mentioned, mixed involvement of stakeholders. The second step was done by the National Review Panel (CRESP, 1996), and the third step is being done by CRESP, as reported herein.

The EMAB stressed the need for consistent categorization: "Categorization of activities must be consistent across the sites if this process is to be a valid decision-making tool." (21 July 1995, p.2) "The categorization of activities needs to be consistent across the sites, clear, recognizable and meaningful." (29 December, p.2 of the attachment). This language was used in Grumbly's 13 December memo. However, the challenge to the field offices was daunting and not met.[2] Consistent categorization across the sites needs much more than a written instruction. It would require fairly extensive collaboration, which apparently was either not possible because of time demands or not required.

The fundamental recommendations of the EMAB were to develop a clear risk-based comparison across sites. This would include "...the goal must be to identify the assumptions used in gathering information, and to develop accurate, credible, and consistent information and data..." (21 July 1995, p.20) "The objective of DOE should be to better integrate an

[1] "There once was an attempt to solicit stakeholder comment. However, due to the time schedule imposed on the process and the methodology of the process, public participation was limited." (p.1) "...the presentation and lack of availability of data prevented a definitive assessment." (p.7)

[2] "The Panel also found a lack of cross-site consistency for the several activities reviewed." "CRESP National Review Panel Report: Review of Risk Data Sheet Information for FY 1998," Executive Summary, p. 2, 1 May 1996.

understanding of risk with other long-term cost projections and future use planning into the budget and other decision-making processes." (21 July, p.3) "Once risks have been categorized, an estimate of costs should be made to reduce urgent risks first." (12 October 1995, p.2) The CRESP RDS review,[3] review of some RDS's, and the information from the IRB meeting indicate this goal has not been achieved. In fact, at the IRB meeting the point was raised by a senior DOE official that cross-site risk comparisons were not possible, that only relative risk rankings at a site could be done. While certainly much harder to do relative risk rankings across sites, without doing so it will not be possible for the DOE to allocate budget priorities to the most serious risks. The Department's overall process made achieving these objectives more difficult. Both EM-30 and EM-40 issued supplemental guidance. In the view of CRESP, these were contradictory to the original guidance. The EM-40 guidance describes the approach as using a DOD-derived methodology (Relative Ranking Evaluation Framework , 12/29/95, p. 2). Several of the preparers who were contacted by CRESP clearly did not understand how the budget formulation process would use the material they generated. This disarray or confusion makes consistent development across sites unlikely. Furthermore, there is a belief among site managers that tight budgeting is not rewarded in the final decision process, nor is showing that compliance and risk reduction can be achieved within budget.

As an example of the possibly confusing guidance given by the department: the 22 May 1996 "Proposed Department of Energy Technical Standard on Guidelines for Risk-Based Prioritization of DOE Activities" describes risk as "including, but not limited to, risk to environment, safety, and health, as well as risk to achieving the desired performance, cost, and schedule." (P.6) The inclusion of performance, cost, and schedule risks is not what EMAB recommended, nor is it consistent with most other descriptions of risk in the various guidance documents.

This document also (p.16) includes the following in the section "Relevant hazards": "Risk measures should consider relevant hazards associated with decision options. The following list indicates some typical risk measures...

1. Public health and safety...;

[3] "There commonly was a lack of sufficient detail in the RDS to understand what the task was and to read a narrative that satisfactorily described the nature of particular risks and the basis for assigning a high, medium, or low designation.' "...the current RDS...are not of adequate quality to withstand scrutiny by outside groups or to effectively serve as documentary support of budget requests to either OMB or Congress."

2. Worker health and safety;...
6. Public assessment/perception;
7. Science and technology capabilities; and
8. Science and technology scope/mission."

The mixing of the last three with the first two is bound to confuse the field employees.

This same document (p.13) lists seven "Candidate decision objectives" which do not include mortgage reduction or worker safety and do include "Maintain Safeguards and Security Maintenance" and "Maximize Cost Effectiveness." The EM RDS Scorecard (included in 30 April 1996 Berkovitz memo) also has seven criteria, which include worker risk and mortgage reduction but do not include the safeguards or cost effectiveness criteria. Furthermore, the 11/15/95 budget guidance does not exactly track with the scorecard in that one of the budget guidance objectives (p.13) is "Cost Effectiveness, including Mortgage Reduction." The list was reaffirmed in the 18 March additional guidance from Guimond (p.1).

Achieving the laudable goal of using risk analysis for the basis of budget development rests upon the availability of defensible, consistent across sites, and comprehensive risk analyses. These exist for almost no EM activity of any significance.

Thus, to the extent that written program guidance is the measure, EM was reasonably responsive to EMAB recommendations. If budget submissions are the measure, the EMAB recommendations have not been implemented. However, these recommendations should be seen as targets, requiring several years of effort to reach. EM should put more effort into a shorter, clearer, and consistent guidance and should further support the efforts of its coordinating group to work across sites to insure consistency.

A new complication has been introduced by the new Assistant Secretary's 10 June 1996 guidance, which introduces the concept of a 10-year horizon and presents seven principles, which are not quite the same as the seven objectives used for the FY 1998 budget preparation. Care must be taken by EM to clarify the relationship between the FY 1998 guidance and the new vision and principles articulated by Assistant Secretary Alm.

VII. RESPONSIVENESS OF THE PROCESS TO THE RECOMMENDATIONS OF THE DEFENSE NUCLEAR FACILITIES SAFETY BOARD (DNFSB)

The 15 November 1995 guidance includes the following in the list of seven core criteria: "Compliance with Laws and Regulations, Enforceable Agreements, Orders for Compliance

and Cleanup Activities, Permits, and Implementation Plans for DNFSB Recommendations." (P.13) Thus, preparers were advised to consider the DNFSB recommendations in developing RDS's and budget submissions. However, the CRESP observers at the IRB noted that while the definition of compliance always included EPA requirements, it did not always include DNFSB recommendations.

A review of 33 DNFSB reports (90-1 to 95-2) indicates that almost all treat individual activities at sites and personnel issues, such as recruitment, training, and retention. To the extent these would be followed in the RDS presentation, they would be at the sub- activity level in most cases. It is here that the CRESP observers found that the DNFSB recommendations were not consistently included.

Two recommendations are of broader applicability. In 94-1, the DNFSB recommended that DOE develop an integrated program plan to develop "safe interim storage" in two to three years for a large array of materials in the DOE Complex. The Board called for formation of such a plan "on a high-priority basis." This sweeping recommendation can be interpreted as the min-safe requirement embedded in EM guidance, although the Board appears to contemplate more than maintaining the current situation in a safe fashion, but to actually modify the conditions and the forms of the materials. There is a sense in the DNFSB recommendations that an urgent need exists to take action. That pressure does not come through in the EM guidance and is noticeably lacking in the new Alm guidance, which refers to compliance only by directing that site plans "Assume Optimum Regulatory Flexibility."

DNFSB report 95-2 recommends that the DOE "Establish a new list of facilities and activities prioritized on the lines of hazard and importance to defense and cleanup programs." This recommendation reflected the Board's concern that as the DOE's plans for facilities have changed, there should be an examination of the plans for these facilities. To the extent that a hazard list can be interpreted from the RDS's, EM is working on such a new list for those facilities under EM responsibility. Of course, the DNFSB recommendations refer to all DOE defense facilities, not just those in EM; and as described above, the EM RDS's currently are a poor vehicle on which to base a priority list of facilities.

VIII. RESPONSIVENESS OF THE PROCESS TO THE RECOMMENDATIONS OF THE NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL

Findings and recommendations resulting from recent evaluations of various aspects of DOE's

environmental management program by the National Academy of Sciences-National Research Council have been presented in the following three reports:

1) "Building Consensus Through Risk Assessment and Management of the Department of Energy's Environmental Remediation Program"(1994);
2) "Improving the Environment: An Evaluation of DOE's Environmental Management Program"(1995); and
3) "Barriers to Science: Technical Management of the Department of Energy's Environmental Remediation Program"(1996).

A. The principal findings and recommendations presented in the first of the above reports --"Building Consensus Through Risk Assessment and Management of the Department of Energy's Environmental Management Program" -- are as follows:

1. Findings:

a) A lack of trust in DOE and its site operators is a major impediment to reaching a consensus on the type and degree of remediation needed, as well as on the process for reaching remediation decisions, at contaminated sites.

b) The multiple concerned parties, or stakeholders, need to be involved throughout the whole process of DOE's environmental risk assessment and risk management, beginning with the planning stages of the process, and not just in the review of the results.

c) Because of differences among stakeholders in values and philosophies, the process must be open, clear, equitable, and inclusive.

d) The absence of complete information about the potential exposure or hazards at a given site should not be an excuse for lack of progress in remediation at the site.

e) Risk assessment concerning possible future outcomes at DOE sites is feasible even in situations where current information is limited, as long as its purposes and limitations are defined.

f) Such risk assessment can provide the following benefits:

   i. it can help to clarify what is known and what is not known about a waste site;

ii. it can help to identify risks that are easily reduced or eliminated, and it can provide an objective basis for decisions on controlling risks, especially for workers in remediation efforts;

iii. it can enable remediation alternatives to be ranked in terms of risks to workers, to the environment, and to the public;

iv. it can provide important quantitative information as input to decisions for allocating resources to remediate sites and can be effective in comparing the cost-effectiveness and potential outcomes of alternative courses of action;

v. it can, by involving the public (in its many guises) in the whole process, contribute to consensus-building for remediation decisions;

vi. it can, as a manifestation of the scientific method, point to sound strategies for gathering information, determining uncertainty, and exploring future outcomes and impacts;

vii. it can, and should, be an iterative process in which a preliminary assessment determines the need for further information and analysis, with sequential iterations before, during, and/or after remediation, as indicated.

2. Recommendations:

a) In the application of the risk assessment process, the following issues should be addressed:

i. the scope of the risk assessment should take into account external, or even global, considerations;

ii. the assessment should be facility-specific so that appropriate stakeholders can participate effectively;

iii. the assessment should include realistic estimates of risk for the exposed critical group, taking into account all relevant health and environmental endpoints, activity patterns, and land use assumptions;

iv. the uncertainty in the estimates of risk should be clearly specified.

b) To reduce the uncertainty in risk assessments and, thereby, improve their utility, more research and data are needed on the following:

i. the relationship between ambient concentrations of contaminants in various environmental media and the resulting doses to critical or target organs;

ii. measurement and surveillance of exposure and of health effects in workers and members of the public (e.g., through the potential use of biomarkers);

iii. information on the toxicological effects of the chemical and radioactive substances of concern, including the effects of mixtures;

iv. predictive modeling of worker and nonworker exposures;

v. the transport and fate of contaminants in soils and groundwater.

c) If DOE's risk assessments are to become fully effective in the future, all levels and programs within the agency should coordinate their risk assessment needs and methods, and DOE should coordinate with other regulatory agencies, ATSDR, and the public in implementing the process.

d) To identify stakeholders and address their concerns appropriately, DOE should mount systematic outreach efforts through site-specific advisory boards (SSABs) and other mechanisms, providing financial and technical assistance for the purpose when needed.

e) To gain the needed credibility for its risk assessments , DOE should explore a new organizational setting for them which would combine the advantages of accessible information with the credibility of an outside group.

3. DOE's Response:

Under the leadership of Assistant Secretary Grumbly, EM has taken steps to respond positively to these recommendations. The Management Evaluation Process (MEP) that is now being used by EM for prioritizing DOE's environmental management activities reflects a creditable effort to develop and implement a system with the features recommended. Of the recommendations listed above, all have been implemented to varying degrees. As yet, however, a iii, a iv, b i - b iv, and d remain to be implemented consistently and adequately across the Complex.

B. The principal conclusions and recommendations presented in the second of the above reports -- "Improving the Environment: an Evaluation of DOE's Environmental Management Program" (1995) -- are as follows:

1. Recommendations

a) Results needed now: Because there is no real consensus as to what cleaning up the Nuclear Weapons Complex means, although the need to get on with the task is generally accepted, DOE should implement a process of decision-making and accountability that includes:

i. a more specific set of goals for the program;

ii. a system for prioritizing tasks that includes among its tools:
-risk assessment (which should consider the perspectives and values of stakeholders, include stakeholder participation, be clear, transparent, consistent and coherent throughout the DOE Complex, and provide for improvement through feedback) and
-cost-benefit analysis;

iii. a peer-reviewed remediation and waste-minimization technology selection and development process that is responsive to the needs of those implementing the remediation;

iv. an overall organizational and management structure that both provides an opportunity for stakeholder input in each of the above activities and that provides incentives for stakeholders, federal workers, and contract workers to implement the activities of the Environmental Management Program successfully;

v. responsible stewardship (i.e., undertaking appropriate near-term or mid-term action to remediate a site to protect the public and the environment even when a permanent solution is not at hand); and

vi. land use planning, based on a formal decision-making framework that:
- provides an opportunity for consensus-based selection of appropriate data, analysis, and criteria for decision making,
- provides an opportunity for stakeholder input at all stages, and
- leads to enforceable agreements which can be modified as further knowledge is gained.

b. Incentives, metrics, and accountability

i. Incentives for DOE and its contractors need to be improved: e.g., through:

- standards and metrics ("benchmarks") for performance-based rating and contracting;
- appropriate use of private-sector models and privatization;
- charging each waste generator for the costs of managing and disposing of its waste;
- disallowance of improper "bundling" of activities;

ii. Disincentives need to be identified and eliminated.

c. Science and technology

i. Because science and technology are important to virtually all activities of EM, and because good solutions have yet to be found for some of EM's environmental problems, EM needs an effective way to bring the Department's and other scientific resources to bear.

ii. To mobilize the scientific resources needed, DOE's technology and development outreach should be extended to all qualified professionals and organizations, regardless of type and location (including international expertise).

iii. Concomitantly with the opening of its R&D procurement system, EM should implement an external peer review system to ensure that the best proposals are selected.

d. Regulatory measures

i. Because of the tensions, potential conflicts, and resulting lack of credibility that are inherent in self-regulation, DOE should cease to regulate its own nuclear-related activities, but the transition from self- regulation to external regulation should be made cautiously and carefully.

ii. In cases where regulatory restrictions impede sensible remedial measures, DOE should make use of regulatory flexibility insofar as possible.

iii. In problems arising when more than one regulatory entity is involved, measures for streamlining the regulatory process should be explored, including the designation of a lead regulator for expediting matters.

e. Public participation

Because EM operates in a political environment in which citizen support is essential to its success, it will lack the credibility it needs unless it builds workable consensus for its activities through stakeholder participation, which will require that all such activities are open and transparent to stakeholders.

2. DOE's Response

DOE's response to these recommendations has been summarized in a report entitled "Improving the Environment: Next Steps. Response to the National Academy of Sciences' Report: Improving the Environment: An Evaluation of DOE's Environmental Management Program" (April 1996).

From this summary of EM's actions and from CRESP's review of EM's implementationof the MEP during the past budget cycle, it is evident that many, if not most, of the features recommended by the NAS study are reflected to varying degrees in EM's current practices and plans. Not all of the recommendations have been incorporated adequately as yet, however, perhaps because the system is still at a relatively early stage of evolution. Yet to be fully and/or consistently implemented, for example, are responses to recommendations calling for: 1) a more specific set of goals for the program; 2) stakeholder participation at all stages of decision-making throughout the Complex; 3) inclusion of cost-benefit analysis in priority-setting; and 4) improvements in incentives and in land use planning. Also noteworthy (as indicated elsewhere in this report) are limitations and inconsistencies in the quality and completeness of the information that is currently being entered into the RDS's at the various sites, which detract from their overall effectiveness and credibility for priority-setting.

C. The findings presented in the third of the above reports -- "Barriers to Science: Technical Management of the Department of Energy Environmental Remediation Program" (1996) -- are as follows (no specific recommendations were offered):

1. Findings

a) Planning that is driven by existing organizational structures and needs rather than by overall agency goals or problems to be solved;

b) Commitments that are made without adequately considering technical feasibility, cost, or schedule;

c) An inability to look at more than one alternative at a time;

d) Priorities that are driven by narrow interpretations of regulations rather than by the purpose of the regulations (i.e., the protection of human health and the environment);

e) The production of documents as an end in itself, rather than as a means to achieve a goal;

f) A lack of organizational coordination;

g) A "not-invented-here" syndrome (i.e., a tendency to "reinvent the wheel") at individual sites because of inadequate communication and coordination with other sites.

2. DOE's Response

CRESP's review of the MEP was not broad enough in scope to permit detailed consideration of these problems. Precisely how EM will respond to this NAS report remains to be seen.

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X. GLOSSARY

ACGIH: American Conference of Governmental Industrial Hygienists

AIHA: American Industrial Health Association

ATSD: Agency for Toxic Substances Diseases Registry

ADS: Activity Data Sheet. A unit in a work breakdown structure which describes a given environmental management activity, or set of activities, to be implemented.

BEMR: "Estimating the Cold War Mortgage. The 1995 Baseline Environmental Management Report." This report, prepared by the Department of Energy in 1995, provided life-cycle cost estimates, tentative schedules, and projected activities necessary to complete the Environmental Management Program.

BLS: Bureau of Labor Statistics

BNL: Brookhaven National Laboratory

CAMPS: Capital Assessment Management Process

CERCLA: Comprehensive Emergency Response, Compensation, and Liability Act, or "Superfund" law.

CRESP: Consortium for Risk Evaluation with Stakeholder Participation, a university-based consortium established in 1995 to develop a methodology for working with stakeholders to improve the assessment of risks to health and the environment at nuclear weapons sites. (See Appendix XI.F)

DOE: Department of Energy

DOT: Department of Transportation

DNSFB: Defense Nuclear Facilities Safety Board

EA: Environmental Assessment

EIS: Environmental Impact Statement

EM: The Department of Energy Office of Environmental Management

EMAB: Environmental Management Advisory Board

EPA: Environmental Protection Agency

ER: Environmental Restoration

ERPS: Environmental Restoration Priority System

FEIS: Final Environmental Impact Statement

FFA: Federal Facilities Act

FUSRAP: Formerly Utilized Sites Remedial Action Program

GNP: Gross National Product

HLW: High-Level Waste

INEL: Idaho National Engineering Laboratory

IRB: Internal Review of Budget

LIPS: Laboratory Integration and Prioritization System

LLNL: Lawrence Livermore National Laboratory

MAU: Multiple Attribute Utility

MEM: Management Evaluation Matrix, a component of the Management Evaluation Process providing criteria for evaluating the likelihood and severity of impacts to be scored in the Risk Data Sheet.

MEP: Management Evaluation Process, the process used by the Department of Energy Office of Environmental Management in formulating its FY 1998 budget (Appendix XI B).

NAS: National Academy of Sciences--National Research Council

NCRP: National Council on Radiation Protection and Measurements

NEPA: National Environment Protection Act, a law enacted in 1970, which requires any activity posing a potential threat to the environment to be preceded by an environmental impact statement.

NPL: National Priority List

OSHA: Occupational Safety and Health Administration

RCRA: Resource Conservation and Recovery Act

RDS: Risk Data Sheet, a form used in the Management Evaluation Process to describe the nature and cost of a given environmental management activity and to characterize the associated risks and other impacts (see Appendix XI.C).

RFA: RCRA Facility Assessment

RI/FS: Remedial Investigation/Feasibility Study

ROD: Record of Decision

RPM: Risk-Based Priority Model

SRS: Savannah River Site

SSAB: Site-Specific Advisory Board

TRC: Total Recoverable Cases

UMTRA: Uranium Mill Tailings Remediation Act

VOC: Volatile Organic Compound

VMT: Vehicle Miles Traveled

WBS: Work Breakdown Structure

WMPEIS: Waste Management Programmatic Environmental Impact Statement

XI. APPENDICES

A. Members of the Peer Review Committee and Subcommittee

B. Flow Chart Indicating the Successive Steps in EM's Management Evaluation Process

C. Sample Risk Data Sheet

D. Comparative Analysis of Applied Ranking Models for ES&H Issues

E. Default Values Characterizing the Health and Safety Impacts Associated with Transport by Truck

F. What is the Consortium for Risk Evaluation with Stakeholder Participation (CRESP)?

APPENDIX A. MEMBERS OF THE CRESP PEER REVIEW COMMITTEE AND TIER-3 PEER REVIEW SUBCOMMITTEE

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***** Member of both Subcommittee and Committee
** Member of Subcommittee alone
*** Chairman of Subcommittee and Committee

APPENDIX B. Flow Diagram Illustrating Successive Steps in EM's FY 1998 Budget Process (from RDS Training Manual)

APPENDIX C. Sample Risk Data Sheet

APPENDIX D. COMPARATIVE ANALYSIS OF APPLIED RANKING MODELS FOR ES&H ISSUES

This section presents a comparative analysis of several models that have been developed to rank Environmental, Health, and Safety (ES&H) issues. The case studies presented in this analysis draw on a mix of private sector and government applications. Each case study presents a summary of the application including the following:

- a problem statement
- the general characteristics and number of issues ranked
- the model objectives
- the form of the model
- relevant characteristics
- comments on the success and status of the model.

The analysis concludes with some general observations regarding the development and use of ranking models for ES&H issues along with important success factors.

Four case studies have been chosen for this analysis. The criteria for selecting these studies were:

- relevance to the DOE EM mission
- diversity of organizations (private and public sector)
- availability of information.

The case studies are:

- Pennsylvania Power & Light Site Ranking Model
- Savannah River Site Reactor Safety Improvement Program
- EPRI PCB Spill Prioritization Model
- EPA Hazard Ranking System

Case Study #1 Pennsylvania Power & Light Co. Site Ranking Model

Problem Statement

Pennsylvania Power and Light Company (PP&L) has implemented a five year strategic plan to improve the management of former and current operating sites which have

potentially been contaminated with hazardous materials. Like all electric utilities, PP&L owns a large number of sites which are geographically dispersed. While PP&L is committed to evaluating these sites to identify and restore contaminated areas, it found that the priorities assigned to these efforts were often driven by outside influences. PP&L believed that despite their efforts to respond to these priorities, the resources expended on these efforts were not producing the maximum benefit to the community and the environment.

It was from this perspective that PP&L began developing a five year strategic plan to improve the management of these efforts. The cornerstone of this plan is a comprehensive agreement with the Pennsylvania Department of Environmental Resources (DER) which covers the remediation of all PP&L sites. PP&L developed a site ranking model which DER reviewed and approved. These priorities are then used to establish annual remediation schedules and budgets. This agreement establishes an important precedent in the state of Pennsylvania whereby PP&L will work with DER to identify, assess and restore potentially contaminated sites according to a mutually agreed upon set of priorities.

The purpose of the strategic plan was to establish an improved method of ranking priority sites and to better manage the resources used to address these sites. For example, PP&L needed the ability to quickly assess the impact of changing priorities on work loads. If, for instance, a site was discovered to be contaminated and pre-sented a risk to the community, PP&L needed a tool to identify what additional resources would be required or which projects must be delayed to address the problem. PP&L understood that this was not possible with its existing management process since the information was not readily available.

In the past, PP&L would concentrate its restoration efforts on sites that responded to regulatory concerns. For example, when PCBs became a significant public concern in the state, attention was focused on the potential contamination from poles where older capacitors once contained PCBs. In response to DER concerns, PP&L undertook a significant effort to identify and investigate potentially contaminated pole sites. This inhibited PP&L from addressing other potentially contaminated sites that may be of greater concern from a public health and environmental perspective. Given that public and regulatory concerns are not always focused on the most immediate public health concerns and tend to shift over time, it was difficult for PP&L to plan work efforts from year to year and ensure that the correct resources were available to meet regulatory commitments.

General Characteristics/Number of Issues

The types of sites owned by PP&L that may be potentially contaminated fall into four broad categories:

Manufactured Gas Plants
Generating Stations
Substations
Distribution Poles

For the DER agreement, PP&L included over 140 sites.

Model Objectives

PP&L desired an objective process to set project priorities based on a balancing of multiple objectives such as minimizing potential public health and environmental impacts, building public trust and maintaining good relations with regulatory agencies. It was necessary to keep in mind the expected results. Many decision problems where multi-attribute utility analysis (MAU) has been used, such as siting a new facility, involve the selection of a single best alternative from a limited number of options. This requires a careful structuring of the decision model to pick up slight differences in project impacts. When ranking a hundred contaminated sites, the primary goal is to segregate the sites into a rough hierarchy.

The difference between ranking a site as number ten or fifteen is not as important as insuring that a site in the bottom third of the list does not belong at the top of the list. In a given year, resources will be expended on a large number of sites, not a few; therefore, the focus is on the top third or fourth group of sites.

Model Form

PP&L developed a methodology to rank sites that takes into account multiple criteria: potential health and safety impacts, environmental concerns, public interest, and corporate impacts. PP&L evaluated several ranking schemes including the EPA's Hazard Ranking System used to rank sites for inclusion on the National Priority List (NPL) in the Superfund program and the SITES model developed by the Electric Power Research Institute (EPRI). PP&L found that these methods do not account for some of the more qualitative factors which influence site restoration priorities. In most cases, these models are focused on risk indicators related to potential public health impacts. They generally utilize information that is not readily available and is costly to generate for many sites. The primary reason that these models are so complex is that they are applied to a large

universe of sites. The types and concentrations of contaminants vary widely as do the physical and demographic characteristics of the sites.

The characteristics of the sites that PP&L has ranked are much more homogenous with respect to the types of potential contaminants. To rank these types of sites, PP&L has developed a ranking model with a simplified public health and environment component that evaluates exposure potentials from multiple pathways. This is consistent with the desire to minimize the cost of ranking the sites so that resources can be applied to identifying and restoring contaminated sites. The PP&L ranking model also deviates from these other methods since it accounts for factors, in addition to public health and the environment, which drive the site priorities.

There are many different techniques such as paired comparisons or cost/benefit analysis that can be used to rank options. These methods are similar in that diverse, sometimes conflicting objectives are balanced to establish priorities. After a review of various decision analysis tools used to establish relative rankings, PP&L used a simplified derivative of multi-attribute utility analysis.

Relevant Model Characteristics

A significant amount of effort was expended in developing a hierarchy of attributes for ranking sites. PP&L developed a list of overall criteria for site priorities based on a review of the 'client needs' of an improved ranking process and stated PP&L corporate goals. This analysis yielded five (5) primary criteria:

- Public Agency
- Corporate Impact
- Health & Safety
- Environment
- Public Interest

One of the criteria, Public Agency, which was identified as having a significant impact on site priorities, was eliminated from the final model since PP&L has established an agreement with DER that addresses all sites.

Decision trees were developed to assist in scoring sites for the Health & Safety and Environment ranking criteria. The other three criteria, Public Agency, Corporate Impact, and Public Interest, have been decomposed into subattributes to facilitate site ranking. For these subattributes, measurement scales were established to score sites. The measurement scales for each of these subattributes are somewhat subjective. Scoring guidelines are used to ensure consistency in the site rankings. A four-point scoring scale

was applied to each subattribute with a zero being the minimum score and three being the highest.

The health and safety scoring model assigns site scores based on the potential exposures from four pathways. The pathways considered for each site depend on the nature of the contamination. The maximum exposure route score is the maximum score that a site can receive for that exposure route for any of the potential contaminants. The minimum score for each exposure pathway is always zero. Implicit in this scoring methodology is the assumption that groundwater exposure poses the greatest risk, while surface water exposure poses the least risk. The site health and safety score is calculated as the sum of the pathway scores. For the environmental scoring model two factors were considered: the type of habitat and the distance to the habitat. The scoring range is from zero for a distant habitat to eight for a nearby wetland.

Weighting factors were assigned for the primary criteria and the sets of subattributes for the Public Agency, Corporate Impact, and Public Interest criteria. A weighting factor survey was designed and distributed to PP&L task force members and additional survey forms were provided to the Pennsylvania Department of Environmental Resources (DER).

The PP&L survey results for these criteria identified Health & Safety as the predominant criterion at 40 percent, with Public Agency, Public Interest, and Environment essentially tied at 19 percent, 15 percent, and 19 percent, respectively. Corporate Impact has the lowest weighting factor at 7 percent.

Model Status

PP&L has incorporated the site ranking model into its management process. The DER agreement is in place, and PP&L Environmental Management staff considers the effort a success.

Case Study #2 Savannah River Site Reactor Safety Improvement Program

Problem Statement

Many of the facilities that make up the DOE Weapons Complex were designed and built in the 1950s. Over the years, production was the primary funding priority at these facilities. With increased public concern over safety, especially in the wake of the Chernobyl accident, these facilities became the object of closer scrutiny by DOE and other external organizations such as the National Academy of Sciences. Increasing demands

were being made for these facilities, especially the reactors, to meet current safety standards. The facility operators were in a position of promising to perform studies and complete safety improvement projects without a corresponding increase in funding or staff.

Similar problems plagued the commercial nuclear industry after Three Mile Island. Based on the success of the Integrated Living Schedule program to address this problem in the commercial utility industry, several DOE contractors, including the Savannah River Reactors Program, undertook the development of similar programs to identify, evaluate, prioritize and schedule improvement work. The purpose of this effort was to develop a management tool that would result in better planning, assuring that the need for safety improvements were understood and assigned an appropriate priority. It was envisioned that this system would provide the operating contractor with a tool to assist in negotiating budgets and project completion dates with DOE.

General Characteristics/Number of Issues

The SRS model was developed to rank work activities related to the SRS reactor program mission. This included hardware modifications, management initiatives, such as training and procedures, and studies. The scope included safety, health, envir-onmental and operational issues. The initial backlog of projects ranked with the model consisted of 200 activities from the 1989 budget year. Additional projects were added to manage the reactor restart effort.

Model Objectives

The SRS Reactors Program management desired a more consistent process to establish project priorities based on a balancing of multiple objectives such as maintaining a high margin of safety, improving availability, reducing occupational risk, and optimizing productivity. A method to objectively and consistently rate studies and projects was considered essential to insure that work priorities reflected a thorough evaluation of the benefits and costs associated with the work and were obtained through consensus decision making rather than by force of personalities.

Model Form

A number of ranking methods were evaluated including cost benefit analysis, multi-attribute utility analysis, and the Analytical Hierarchy Process. SRS examined systems in use by commercial utilities and discovered a broad array of methods being employed. The U.S. Nuclear Regulatory Commission (NRC) did not endorse any particular method, relying on the utility to determine a method which best met its needs.

The method chosen for this program utilized a simplified derivative of multi-attribute utility analysis. This method was chosen because it was developed for situations where multiple, often conflicting, objectives impact the decision process. MAU also explicitly captures the value preferences of the decision makers in the form of weighting factors.

To make the process easier to implement, several simplifying assumptions were made. First, all utility curves were straight line, an assumption which may not hold in all cases. However, facility management felt that the development of utility curves would be difficult, time consuming, and would not increase the accuracy of the project priorities. Secondly, the assumption was made that the attributes were independent, allowing the use of additive utility functions.

In making these assumptions, it was necessary to keep in mind the expected results. Many decision problems where MAU has been used, such as siting a new facility, involve the selection of a single best alternative from a number of options. This requires a careful structuring of the decision model to pick up slight differences in project impacts. When ranking several hundred projects, the primary goal is to segregate the projects into a rough hierarchy. In a given year, resources would be expended on a large number of projects, not a few, therefore, the focus was on the top third or fourth group of projects.

Relevant Model Characteristics

The model consisted of those factors that were important in setting project priorities. The selection process was guided by the desire to obtain a minimum number of attributes that were not redundant, captured the goals of the organization, and were measurable. The final list of attributes compared favorably with the corporate mission statement which reflected the desire to run a safe, efficient operation which met its production requirements without causing negative impacts on the environment. For each of the primary attributes, up to seven subattributes were identified to assist in rating the project impacts. This hierarchy of attributes is presented below:

Public Safety		Environment
Natural Phenomena		Hazardous/Radioactive Waste
Reactor Events		Thermal Pollution
Core Damage Prevention		Radioactive Pollution
Activity Release Prevention		Non-radioactive Pollution
Emergency Response		
Human Reliability		
Production		Oversight & External Relations
Production Capability	DOE	
Reactor Lifetime/Maintenance		Outside Evaluators
Reactor Operating Costs		
Industrial Safety		Safeguards & Security
Attitude/Knowledge		Entry Detection
Exposure to Hazards		Entry Prevention
Radiation Exposures		Insider Threat
Housekeeping	SNMA	
Personnel Efficiency		Cost
Worker Morale		
Worker Efficiency		
Quality of Work		
Training		
Effects of Work Place Environment		
Fitness for Duty		

The selection of attributes used input from both the operating contractor and DOE. Each project is evaluated and assigned a score of between -10 and +10 for each subattribute. The total project score was calculated as:

$$St = Wpa * Wsa * Ssa$$

Where:

St	=	Total Score
Wpa	=	Primary Attribute Weight
Wsa	=	Subattribute Weight
Ssa	=	Subattribute Score

Weighting factors were derived for each attribute, using paired comparisons to assess the relative importance of each. Within each primary attribute, weights were assigned to each

subattribute using a direct scoring method. Primary attribute weights were assessed by a number of contractor and DOE managers and averaged. Consensus subattribute weights were assigned by a group of managers. Total scores ranged from -100 to 100.

Rating guidelines were used to assign scores to each attribute. The guidelines were developed with the understanding that the impact of most projects would be qualitatively understood, but not always quantified. The rating guidelines provided a mixture of qualitative and quantitative guidance for assigning scores. The ratings that could be assigned included "Very Significant," "Significant," "Moderate," and "Slight." These correspond to scores of 10, 5, 2, and 1. The rating guidelines reflect this scoring assignment and the fact that linear utility curves were assumed.

Uncertainties in the project outcome were explicitly addressed in the rating process by requiring the evaluator to assign a probability of success to each non-zero score. The categories used were "High," "Moderate," and "Low," corresponding to probabilities in the range of 100 to 66%, 65 to 33%, and below 33%, respectively. The corresponding rating is devalued by one or two categories depending on the probability of success and is never devalued beyond a slight impact.

Model Status

The result of this process was a ranked list of projects which were technically reviewed and received management approval. This became the official list of approved work priorities which are incorporated in the long range and near term schedules. When the Reactors program was suspended in 1989, full implementation and adherence to the RSIP program became a condition of restart. The system was in use until the reactors were shut down. Similar systems were adopted by other M&O contractors.

Case Study #3 EPRI PCB Spill Prioritization Model

Problem Statement

The management of polychlorinated biphenyls (PCB) spills became a major issue for utilities in the late 1980s. PCBs became a high profile environmental concern and utilities often had hundreds of sites to evaluate for PCB contamination and subsequent remediation. In 1990, the Electric Power Research Institute funded development of a model, PSPM, to help member utilities set priorities among PCB contaminated sites.

General Characteristics/Number of Issues

The ranking model was designed exclusively for PCB contamination. It addressed distribution poles, indoor storage facilities, outdoor storage facilities, and substation capacitor banks. A typical utility may have from tens to hundreds of sites to rank.

Model Objectives

EPRI's objective in developing PSPM was to develop a simple prioritization method for utilities with a large number and a variety of PCB contaminated sites. An additional requirement was the use of limited data.

Model Form

The PSPM model uses a scoring approach to calculate relative risk scores for three risk measures: individual risk, population risk, and environmental risk. Scores are calculated for each category of PCB spill sites for each risk measure. No total site score is calculated; utilities were encouraged to develop their own method of combining the three risk scores to develop site priorities.

Relevant Model Characteristics

One of the primary inputs to PSPM is information on PCB concentrations in air, water, and soil. If this information is unknown, defaults are calculated based on spill size and history. Potential receptor populations must be defined by entering numbers of potentially exposed individuals and distance from the site. The model calculates exposures from each media to calculate relative risk scores that are given in units of micrograms exposure per year. The model evaluates exposure from dermal contact, soil ingestion, inhalation, and crop ingestion. The exposed population includes workers and the public.

Model Status

The PSPM model was implemented by a number of utilities that are presumably still using the results to guide remediation efforts. Some utilities, such as PP&L, have abandoned the model in favor of more general models for all sites.

Case Study #4 EPA Hazard Ranking System

Problem Statement

The EPA, under the CERCLA legislative mandate, is tasked with maintaining a list of sites on the National Priority List (NPL) in 40 CFR 300, Appendix B. To sort through all candidate sites, EPA devised the Hazard Ranking System (HRS) to score sites and select those for inclusion on the NPL. Given the consequence of including a site on the NPL, the HRS must stand up to rigorous review.

General Characteristics/Number of Issues

The HRS was designed to evaluate the hazard potential from any type of site that is a candidate for inclusion on the NPL. This covers a broad array of sites and contaminants which number in the thousands.

Model Objectives

The objective of the HRS is to calculate a single-site score that can be compared to a threshold value for inclusion on the NPL. The ranking model must be able to address the thousands of unique sites in deriving a single, relative risk score.

Model Form

The HRS uses an extremely detailed scoring model which accounts for multiple exposure pathways, varied waste types and quantities, and variable populations. The model description is contained in Appendix A to 40 CFR Part 300, a 90-page document. Individual exposure pathway scores are calculated using either site specific information or EPA provided default values. Site scores range from 0 to 100 and are intended as a relative indicator of risk.

Relevant Model Characteristics

The HRS uses the following information to calculate scores:

- Likelihood of Release
- Waste Characteristics
- Groundwater Migration
- Surface Water Migration
- Soil Exposure
- Air Migration
- Radioactive Contamination

The data required to calculate a site score is extensive and requires significant resources to rank a site. The HRS model does include default data for much of the information based on salient site characteristics.

Model Status

The HRS model is used as the primary criteria for identifying sites on the NPL. It has undergone significant revisions and updates since its inception. Some states use variations of the HRS to maintain state lists of priority sites.

Comparison of Ranking Models

The models reviewed in this analysis are a small subset of the ranking models in use. In general, scoring models and weighted scoring models are commonly used for ranking ES&H issues. From the examples reviewed above, several generalizations may be made. First, the complexity of the model is often driven by the number and diversity of issues to be ranked. In order of complexity, the four models presented above are:

1) EPA Hazard Ranking System
2) Savannah River Site Reactor Safety Improvement Program
3) Pennsylvania Power & Light Site Ranking Model
4) EPRI PCB Spill Prioritization Model

This order reflects the number and complexity of issues being evaluated. In addition, there is a trend towards using less complex models for ranking issues for internal management versus the EPA mission of screening sites for the NPL.

All four models presented above were successful in meeting many of the stated objectives. The National Academy of Sciences conducted a critical review of hazardous waste site ranking schemes in 1994 (NAS 1994). The report reviewed methods being used by the EPA, DOD, DOE, and several states. The final report recommended that the government consider developing a unified national approach to setting priorities.

APPENDIX E. DEFAULT VALUES CHARACTERIZING THE HEALTH AND SAFETY IMPACTS ASSOCIATED WITH TRANSPORT BY TRUCK

This appendix presents an overview of the potential unit impacts associated with the transport of radioactive and chemically hazardous materials by truck. It demonstrates that

default unit risk values, expressed in units of fatalities per vehicle mile, can be used to more fully characterize the health and safety impacts of activities requiring the transport of large quantities of material, including radioactive and chemically hazardous substances.

During the May 20-24, 1996 IRB meeting, there was some discussion of the cost of transportation, which included 600,000 shipments per year -- for a total of 30 billion dollars. In order to better control these costs, EM is in the process of re-engineering and privatizing the transportation program. In addition, it was acknowledged that a major source of risk is vehicular accidents. The EM presentation indicated that 20.3 million dollars will be needed for transportation in 1998, and support of EM programs will require 270 million truck miles. For large trucks, the number of fatalities per 100 million vehicle miles traveled in 1992 was 2.6; i.e., 2.6E-8 per VMT (DOT 93). Hence, based on standard DOT statistics, about 7 fatal truck accidents can be projected for 1998 due to waste shipment by truck. This risk is not significantly increased because hazardous materials are being shipped; i.e., the fatality risk per vehicle mile is not increased because hazardous materials are being shipped. In fact, the risks per vehicle mile for hazardous materials may be lower because of the attention given to routing and safe transport. For example, the Department of Commerce (DOC 87) states that the accident fatality from the shipment of hazardous material is 1.53E-8 fatalities per vehicle mile, as compared to a fatality rate of 6.6E-8 for all interstate shipments for heavy combined trucks, regardless of cargo.

In addition to national statistics, DOE's Waste Management Programmatic Environmental Impact Statement (DOE 95a) assessed human health risks associated with transporting various waste materials to ensure a complete appraisal of the impacts of each PEIS alternative being considered. The transportation risk assessment presented in Appendix E of that document determines transportation-related risks by considering the total amount of waste of each type shipped over each specific route for each alternative considered in the PEIS.

Two types of impacts were evaluated: cargo-related impacts (radiological) and vehicle-related impacts (nonradiological). Cargo-related impacts on human health during the transportation of radioactive materials would be caused by exposure to ionizing radiation. Radiological risks were assessed for routine transportation and for accidents involving the radioactive cargo. This included the exposure of persons to low levels of external radiation near loaded shipments, and exposure through multiple pathways due to the release of radioactive materials to the environment during an accident. The radiological impacts were expressed as health risks in terms of the number of estimated latent cancer fatalities in exposed populations for each of the alternatives.

In addition to the radiological risks posed by transportation-related activities, risks were

also assessed for vehicle-related causes, which were independent of the radioactive nature of the cargo and would be incurred for similar shipments of any commodity. The vehicle-related impacts were assessed for routine conditions and accidents. During routine transportation, the public was exposed to increased vehicular exhaust emissions, primarily in urban environments. The accident risk was due to potential transportation-related accidents that result in fatalities caused by physical trauma unrelated to the shipment's cargo. State-specific and location-specific rates for transportation-related fatalities were used in the assessment.

For the PEIS, representative truck routes were determined for all possible pairs of origin and destination sites. The routing model HIGHWAY 3.1 (Johnson et al., 1993) was used to determine the route, which, in turn, gives the total shipping distance between each origin/destination pair and the fractions of travel in rural, suburban, and urban population density zones. Based upon the route selected, HIGHWAY determines the fractions of travel in each zone and, along with the population densities for each State, determines the total potentially exposed population along each route and the expected frequency of transportation-related accidents.

The RADTRAN 4 (Neuhauser and Kanipe, 1993) computer code was used for routine and accident radiological risk assessments to estimate the impacts to collective populations. This code was developed by Sandia National Lab in the late 1970s to calculate populations risks associated with transporting radioactive materials. The RADTRAN 4 calculations of risk for routine highway transportation includes exposures of: persons living or working along the route, persons sharing the route, persons at stops, and for the truck crew members. The code adds the dose for the first three groups to give the dose to the public, while the fourth group represents the dose to workers.

The radiological accident risk was defined as the product of the accident consequence (dose) and the probability of the accident occurring. In this respect, the RADTRAN 4 code estimates the collective accident risk to populations by considering a spectrum of transportation-related accidents, including low-probability accidents with high consequences and high-probability accidents with low consequences. The collective population dose was calculated based upon the dispersal of the radioactive material and subsequent dose due to external exposure to the passing cloud, external exposure to contaminated soil, internal exposure from inhaling airborne contaminants, and internal exposure from ingesting contaminated food.

The collective radiological risks were calculated for each specific alternative in the PEIS based upon the origin/destination distance, the representative route, the number of shipments, and the radiological and physical properties of the waste type being considered.

The nonradiological risks for routine transportation were associated with the air pollutants generated by the transporting vehicles during shipment, independent of the nature of the shipment. The health endpoint assessed under these conditions was the excess latent mortality caused by inhalation of vehicular exhaust emissions in urban areas. Risks were summed over the entire route and over all shipments for each alternative in the PEIS.

The vehicle-related (nonradiological) accident risk refers to the potential for transportation-related accidents that directly result in fatalities that were not related to the shipment's cargo. This risk represents fatalities from mechanical causes. State-specific transportation fatality rates were used for each case by multiplying the total distance traveled in each state by the appropriate state rate for transportation-related fatalities. In all cases, the nonradiological accident risks were calculated by using distances for round-trip.

For calculating nonradiological accident risks, vehicle fatality rates were taken from data provided in Saricks and Kvitek (1994). These rates were specifically for heavy combination trucks involved in interstate commerce, typically used for shipping radioactive wastes. Truck accident rates were computed for each state on the basis of statistics compiled by the DOT Office of Motor Carriers for 1986 to 1988. Fatalities include crew members and the public and were based upon deaths occurring any time within 30 days of the accident. The accident rates presented in the PEIS use separate accident rates for travel in rural, suburban, and urban population density zones in each state. Therefore, total accident risk for a case depends on the total distance traveled in various population zones in each state for each alternative, and does not rely on national average statistics.

The PEIS presents results of the transportation risk assessment for four types of radioactive waste: high-level waste, low-level waste, transuranic waste, and low-level mixed waste. For each waste type, results were presented for various alternatives. The number and location of potential treatment, storage, and disposal sites differs for each specific alternative, and the number of alternatives considered varies among waste types. Table XI.E.1 summarizes the results of the PEIS transportation risk assessment. The radiological fatalities per mile traveled are shown along with the nonradiological fatalities due to transportation accidents. For each waste type, the average number of fatalities for all alternatives was shown, along with the minimum and maximum values for each.

It is significant to note that in all cases, the radiological impacts are roughly equivalent to the nonradiological impacts. Radiological fatalities are higher for high-level waste (9.57E-8 mi^{-1}) and transuranic waste (7.92E-8 mi^{-1}) and lower for low-level waste (3.04E-8 mi^{-1}) and low-level mixed waste (3.30E-8 mi^{-1}). However, for the transportation-related fatalities, the variation from one waste type to another is very slight, averaging about 6.6E-8 mi^{-1}.

The accident rates used in the PEIS for this assessment were computed using interstate shipments for heavy combination trucks regardless of the cargo. Saricks and Kvitek point out that shippers and carriers of radioactive material generally have a higher than average awareness of transportation risk and prepare cargos and drivers for such shipments accordingly. This preparation should have the twofold effect of reducing component and equipment failure and mitigating the contribution of human error to accident causation. These effects were not considered in the PEIS accident assessment.

In theory, when selecting a given activity to resolve a given problem through the RFS or NEPA process, the transportation impacts of alternatives are considered.

However, when prioritizing activities, consideration must again be given to the overall value of the activity, relative to other activities, considering transportation impacts. The information needed to make such assessments should be available in the CERCLA, RARA, and NEPA documentation, such as the WMPEIS, originally prepared in support of the activity. If such documentation is not available, estimates for the purpose of scoring the MEM can be readily derived using DOT accident statistics.

Table XI E-1

DOE Waste Management Programmatic Environmental Impact Statement

Population Impacts of Transportation of Radioactive Waste (Fatalities per Vehicle Mile)

Waste Type	Average	Maximum	Minimum
High-Level Waste			
Radiological fatalities/mile	9.57E-8	9.72E-8	9.36E-8
Nonradiological fatalities/mile	6.18E-8	6.81E-8	5.85E-8
Low-Level Waste			
Radiological fatalities/mile	3.04E-8	3.77E-8	2.77E-8
Nonradiological fatalities/mile	6.44E-8	7.11E-8	5.37E-8
Transuranic Waste			
Radiological fatalities/mile	7.92E-8	8.06E-8	7.75E-8
Nonradiological fatalities/mile	7.03E-8	7.08E-8	6.98E-8
Low-Level Mixed Waste			
Radiological fatalities/mile	3.30E-8	3.48E-8	2.95E-8
Nonradiological fatalities/mile	6.85E-8	7.39E-8	6.15E-8

APPENDIX F. WHAT IS THE CONSORTIUM FOR RISK EVALUATION WITH STAKEHOLDER PARTICIPATION (CRESP)?

The Consortium for Risk Evaluation with Stakeholder Participation (CRESP) is a university-based consortium led by the Environmental and Occupational Health Sciences Institute (EOHSI), in New Jersey, and the School of Public Health and Community Medicine of the University of Washington, in Seattle. The Institute for Evaluating Health Risks, in Washington, D.C., is also one of the founding institutions. Designed to be an independent institution for developing integrated approaches to risk assessment, CRESP was selected in DOE's 1994 Notice of Proposed Interest competition and was awarded a five-year cooperative agreement on March 13, 1995.

CRESP's mission is to enhance the protective and cost-effective cleanup of the nation's nuclear weapons production waste sites by improving the scientific and technical basis of environmental management decisions, and by enhancing stakeholder participation in the process. Hence CRESP's specific aims are: 1) to facilitate scientifically informed problem solving among those who have a stake in addressing the risks of wastes at DOE's sites and facilities, 2) to strengthen national methods as well as to give input on local issues through site-specific research work, and 3) to provide an independent, credible, publicly-available review of the data and methods needed for DOE's iterative evaluation and selection of risk management and restoration options. CRESP seeks an approach to research and to risk assessment that generates scientifically valid responses to concerns expressed by diverse stakeholders.

Responsibility for the oversight of all CRESP activities resides with its Management Board, consisting of Bernard D. Goldstein, M.D., John A. Moore, D.V.M., Gilbert S. Omenn, M.D., Ph.D., and Charles W. Powers, Ph.D. Eight separate task groups, drawn from the two universities, have been established to organize research and operations for CRESP.

CRESP's Independent Peer Review Committee, headed by Arthur C. Upton, M.D., former Director of the National Cancer Institute, peer reviews CRESP's work and has also provided the review of DOE's FY 1998 budget formulation process reported herein. The members of the Committee are listed in Appendix XI.A.