

## RESOURCE ALLOCATION SUPPORT SYSTEM (RASS): SUMMARY OF THE 1992 PILOT STUDY

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### ABSTRACT

The Resource Allocation Support System (RASS) is a decision-aiding system being developed to assist the U.S. Department of Energy's (DOE's) Office of Waste Management in program and budget decision making. Four pilot studies were conducted at DOE field offices in summer 1992 to evaluate and improve the RASS design. This paper summarizes the combined results of the field office pilot studies. Lessons learned and directions for future RASS developments are also presented.

### INTRODUCTION

The Resource Allocation Support System (RASS) is a decision-aiding system being developed to assist the U.S. Department of Energy's (DOE's) Office of Waste Management (WM) in program and budget decision making. The RASS pilot study was intended to test the practicality of the RASS design concept as an aid in evaluating proposed work across the WM system. This paper summarizes the process and combined results of pilot studies conducted at the Albuquerque, Chicago, Richland, and Rocky Flats field offices of DOE during June-September 1992. The pilot study results were only used to test the RASS process and were not used for any budget decision making.

The RASS development process has involved interactions with three groups (Fig. 1):

- *DOE Field Office/Headquarters (FO/HQ) Working Group.* This group consists of DOE field office and Headquarters staff who will be the primary users of RASS. This group provides a practical perspective on reasonable and acceptable characteristics for RASS.
- *Technical Review Group (TRG).* This group of experts in decision analysis, operations research, risk estimation, and program planning helps ensure that RASS is technically sound and credible.
- *External Parties.* Interviews were conducted with more than 80 persons in summer and fall 1991 as

initial concepts for RASS were studied. These individuals represented more than 50 organizations. Some of these individuals participated in a national workshop in January 1992 to discuss the RASS design. External parties participated in the Richland and Rocky Flats pilot studies. A second national workshop is planned for March 1993 to examine the pilot study results.

An important feature of RASS is that it allows different perspectives to be considered by DOE decision makers. Different individuals or organizations, such as Tribal Governments, States, and local groups, may have different views that DOE on the relative importance of RASS objectives. RASS will make it possible for DOE to examine and consider these different perspectives in reviewing programs and budget proposals and to be better informed.

A decision will be made in early 1993 as to whether a full-scale test of RASS will take place at all DOE sites in summer 1993. DOE's decision will consider the input and comments of the DOE field offices, members of the TRG, and members of Tribes, States, the U.S. Environmental Protection Agency, and general public. Although the pilot study tested the conceptual design of RASS, a more intensive exercise is needed before an accurate assessment can be made concerning the value of RASS under realistic working conditions. If a full-scale test should be conducted, DOE management will evaluate those results and decide if RASS should be used in future years as one element of its program and budget review process. RASS results would be used in conjunction with other information (e.g., legal agreements, program plans) in evaluating proposed work.

### HOW RASS WORKS

To describe how RASS operates, it is necessary to define three related terms: activities, funding units, and funding unit alternatives. An *activity* is a specific proposal for work, such as new construction; an upgrade to an existing facility; routine maintenance; treatment, storage, or disposal of waste; or monitoring of the environment. A *funding unit* is a logical grouping of activities consistent with WM program planning. A funding unit may be an installation, a facility, or a major

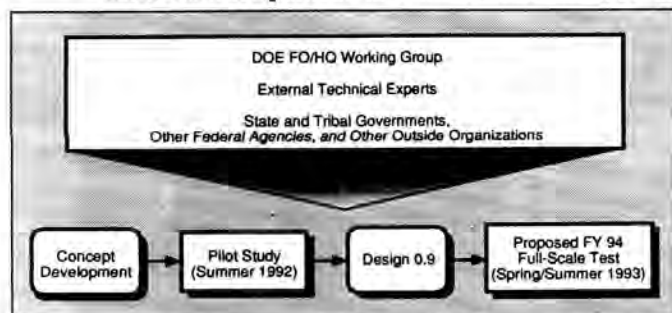


Fig. 1. Groups and organizations involved in the RASS development process.

\* Work Supported by the U.S. Department of Energy, Office of Environmental Restoration and Waste Management, under contract W-31-109-Eng-38.

activity. A *funding unit alternative* is a specified level of funding for each activity in a funding unit.

For example, the K Basins at Hanford were considered as *one funding unit* in the RASS pilot study. The K-East and K-West storage basins provide storage of irradiated nuclear fuel. This funding unit consists of five activities (however, most funding units in the RASS pilot study had fewer than five activities):

- Ensure continuity of operations (including maintenance and surveillance),
- Upgrade equipment (including encapsulation and repackaging),
- Respond to regulations (including environmental oversight and sampling and monitoring),
- Extend life of the basins (including security and seismic equipment), and
- Construct a water supply system (new water plant to save on operation and maintenance costs and to conserve energy).

Three funding unit alternatives were analyzed for this funding unit. The alternative with the highest funding request addressed the needs of all five activities. The alternative with lowest funding request achieved minimal or no progress on the five activities. The third alternative was between the high and low alternatives in terms of the funding request and in the achievement of needed work.

Each funding unit alternative included in the pilot study was scored (rated) with respect to the RASS objectives for WM. For the RASS pilot study, these objectives addressed:

- Compliance with regulations, orders, treaties, and agreements;
- Near-term risks to human safety and health (S&H);
- DOE waste management needs, and
- Waste Management system costs.

Other objectives were identified during discussions with the three groups. Several of these additional objectives are under study for possible addition to RASS for the proposed full-scale test.

Nine scales were defined to measure performance with respect to the four RASS objectives for WM listed above. Compliance for proposed WM work is measured on a single scale, as is WM system costs. Safety and health impacts are measured by four separate scales, and waste managed has three scales of performance. The nine scales are:

1. Compliance - A scale composed of categories that indicate the "state of compliance" that may result from proposed expenditures in a given year.
2. Morbidity and Mortality for the Public (air, groundwater, and surface water exposure pathways) - Morbidity is converted to equivalent mortality. Estimates include radiation and chemical risks to humans from exposures through air, groundwater, or surface water pathways.
3. Morbidity and Mortality for the Public (transportation accidents) - Separate calculations account for risks due to transporting wastes off-site.
4. Morbidity and Mortality for Workers - Calculations for workers include risks due to construction and operations activities.

5. Safety Program Expenditures - The present value of funds, beyond those required by laws or agreements, to be used for programs designed to reduce safety and health risks.
6. Capacity/Throughput - An estimate of the amount of waste to be treated, stored, transported, or disposed. Although WM's primary activities involve HLW, LLW, TRU, sanitary, hazardous, and mixed wastes, RASS allows for other types of activities.
7. New Capacity Status - A measure of the schedule status for new construction activities (e.g., for new treatment, storage, or disposal facilities). The definition includes upgrades to existing facilities and equipment.
8. Five-Year Plan Milestones Met - An account of performance with respect to meeting Headquarters-tracked Five-Year Plan milestones.
9. Waste Management system costs - The present value of budget requests, system cost savings, and system cost penalties (e.g., fines).

As many as four alternatives were examined for each funding unit in the pilot study. These alternatives differ in the level of funding requested for a funding unit. Guidance provided to participants included definitions of four suggested alternatives. These definitions, which are likely to be modified for the proposed full-scale test, are:

- *Core*: This alternative has the lowest funding request in the target year. It generally includes funding to maintain equipment or a facility in a safe and ready-to-operate mode but does not provide operating funds. This alternative addresses activities only in the standby mode and may have compliance problems because of the standby status. (DOE intends to meet its compliance commitments. For the purpose of demonstrating to decision makers the increase of benefits that would result from funding at the operations level rather than at a lower level, WM believes that RASS should consider at least one funding unit alternative below the operations level. Because WM does not determine ultimate budget levels and may receive less than the amount needed to fund all funding units at the operations level, WM needs contingency plans for funding a funding unit at less than the operations level.)
- *Intermediate*: This alternative represents a funding option between the core and operations alternatives.
- *Operations*: This alternative includes all operating, maintenance, and capital expenses needed to conduct scheduled waste management activities in a safe, efficient manner and achieves compliance to the highest possible degree with all applicable laws, regulations, agreements, treaties, and DOE orders.
- *Long range*: This alternative has the highest funding request in the target year. It includes facility upgrades or new construction. Activities for this alternative typically offer long-range benefits to the waste management system.

A multiobjective utility function (MOUF) is needed to assign a utility value to each funding unit alternative. A utility value is a measure of the degree to which an alternative meets the RASS objectives for WM. This concept is depicted in Fig.

2, which indicates that an MOUF operates on the scoring data for each funding unit alternative for a funding unit to produce a utility value. Each funding unit alternative has one utility value. This utility value is actually based on a large number of scoring estimates made by funding unit managers. RASS "rolls up" these scores into nine numbers that enter into the utility calculation.

The RASS allocation algorithm uses target-year cost data and the utility of each funding unit alternative to determine an allocation of a fixed WM budget among the funding units that maximizes utility. This procedure is indicated in Fig. 3.

**PILOT STUDY FUNDING UNITS**

The pilot study included a total of 33 funding units, with a maximum total WM funding request of over \$300 million for FY 1994, which is less than 10% of WM's budget request. Richland defined 10 funding units that covered a wide range of activities from grout disposal to building demolitions. Rocky Flats defined two funding units, covering off-site transport of wastes and operating and upgrading a liquid waste treatment facility. Chicago scored 12 funding units from four sites (Princeton Plasma Physics Laboratory, Brookhaven National Laboratory, Argonne National Laboratory [ANL]-West, and ANL-East) that included a wide range of activities. The Albuquerque pilot study examined 9 funding units from three sites (Los Alamos National Laboratory, Kansas City Plant, and Mound). DOE field office staff and contractors (hereafter called project managers) chose the funding units,

defined the funding unit alternatives, and provided the scoring data.

**PILOT STUDY OBJECTIVES**

Six pilot study objectives were selected based upon discussions with the DOE FO/HQ working group, the TRG, and external parties.

- Objective: Determine whether proposed activities can be meaningfully evaluated on the scales developed to score funding unit alternatives.
- Outcome: Pilot study participants were generally able to score a diverse set of activities on RASS pilot study scales. Some difficulties were encountered in the early pilot studies (Chicago and Albuquerque) that required slight modifications to some scales. These scale changes improved the accuracy of the scoring and provided the scorers with more meaningful scales. For example, the compliance scale was modified to more accurately reflect possible DOE regulatory actions. Also, additional guidance was required to improve scoring consistency on the compliance scale.

The safety and health scale, which addresses the risk to the public through air and water pathways, measures risk within ranges (e.g., 0 to 1 illness). Although no participants had major difficulties in measuring the risks on this scale, some participants felt that additional guidance is required to produce more consistent results across sites.

The scale that measured waste managed did not include industrial wastewater and did not differentiate among TRU wastes. Although scoring was not a problem, the scales used in the pilot study do not adequately take into account the variability in waste type and should be modified to provide a more meaningful evaluation of the value of waste processing.

Some proposed activities (e.g., research and development, and activities other than treatment, storage or disposal) did not score as well because the entire value of these activities was not captured by the scales used in the pilot study. Other scales and objectives could be created to measure these contributions to WM programs.

- Objective: Provide an opportunity for the DOE FO/HQ Working Group, external parties, and the Technical Review Group to observe the mechanics of the proposed system and offer suggestions for its improvement.

Outcome: Four DOE Field Offices participated in the pilot study and one field office (Oak Ridge) observed one pilot study. All non-participating Working Group members were invited to observe any of the four pilot studies, but attendance was limited mainly due to scheduling conflicts.

External parties participated in the Richland and Rocky Flats pilot studies. At Richland, external parties participated in an all day review session the last day of the pilot study. They heard presentations and commented on the RASS scales, selection of funding unit alternatives, scoring judgments made by DOE

| Measures Alternatives | Compliance-Related Shutdowns | Equivalent Worker Fatalities | ... | WM System Cost | Utility |
|-----------------------|------------------------------|------------------------------|-----|----------------|---------|
| Core                  | 23                           | 0.2                          | *** | \$2M           | 0.3     |
| Intermediate          | 19                           | 0.3                          | *** | \$5M           | 0.4     |
| Operations            | 10                           | 0.4                          | *** | \$7M           | 0.5     |
| Long Range            | 00                           | 0.5                          | *** | \$10M          | 0.7     |

Fig. 2. A multi-objective utility function operates on nine summary scores for each funding unit alternative to calculate a utility value for each alternative.

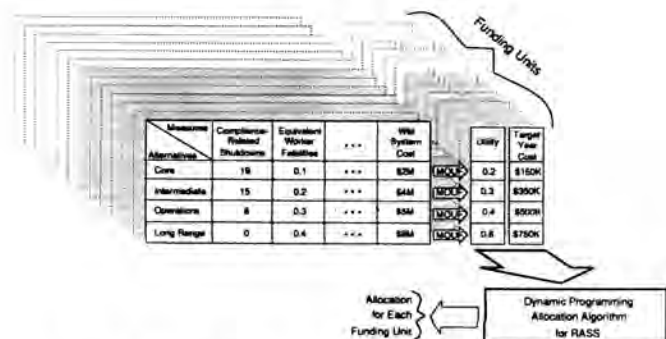


Fig. 3. A dynamic programming algorithm uses target-year cost and utility data to allocate funds among funding units.

and contractors, and the results from the RASS model. Two individuals from the Congressional Research Service (one is a member of the TRG; both attended the first national workshop) also participated in the Richland pilot study. They observed the scoring process and attended the review session held on the last day.

The external participation at Rocky Flats was more interactive. External parties were involved in the Rocky Flats pre-pilot meeting and the pilot study. For example, because the Rocky Flats pilot study had two funding units, the participants observed the mechanics of RASS at a very basic level.

*Objective:* Evaluate the availability of quality data and the capability of project managers to make judgments to support RASS implementation.

*Outcome:* Field office staff and contractors were able to make judgments needed to define funding unit alternatives and to score these alternatives on the scales. Approximately 50 field office staff (four offices) and contractors (nine sites) were involved in the scoring of funding unit alternatives. In addition, several external parties were involved in the scoring at Rocky Flats and did not have major difficulties. All of this scoring was conducted with very little pre-training. The first part of each scoring session could be characterized as an on-the-job training session. In the next RASS application more through training should be added to aid the scorers.

Most scoring data was provided directly by project managers. In some cases, project managers had difficulty in determining appropriate scores. In those instances, ANL staff provided assistance. Sometimes, detailed quantitative analyses were available to support their judgments. However, field office staff, contractors, and external parties that participated in the pilot study felt that additional scoring guidance would improve the consistency of scoring.

- *Objective:* Determine the level of effort needed by field offices and contractors to work with the system.  
*Outcome:* Effort needed to score funding units varied considerably. A brief introductory lecture was the only training given prior to the scoring sessions. Therefore, each scorer usually required some time to understand what information was being requested. The amount of time required to score a single funding unit varied between one and three hours. The longer times usually corresponded to funding units with multiple activities that required more detailed scoring, while the shorter times were usually associated with single- activity funding units. If a scorer was responsible for more than one funding unit, the time required for scoring the second or third funding units was usually less than half of that required for the first funding unit.

The general conclusion is that RASS will require additional effort beyond what is typically required for current proposal preparation (i.e., the activity data sheet process). However, if the RASS process can be

coordinated with proposal preparation activities then the additional effort required for RASS is reasonable.

- *Objective:* Identify the type and amount of training and guidance needed to successfully implement the system.

*Outcome:* Although the scoring at all pilot studies proceeded quite well, all field offices felt that more detailed written guidance on how to score activities on the scales and training would be required for any larger test of RASS because the RASS development team will not be present to assist in scoring. Group training that includes scoring workshops would be useful. A suggestion was made by the DOE FO/HQ Working Group to develop a training film that could be used as an introductory training program for RASS. All three types of training and guidance will be considered for the proposed full-scale test.

- *Objective:* Determine an appropriate role for the public should RASS prove to be a useful tool.

*Outcome:* Because any RASS implementation will be integrated with the overall planning activities at a site, the DOE FO/HQ working group recommended that public involvement in the RASS development program should be consistent with the site's overall public involvement program. It is expected that different methods will be used because unique conditions exist at each site.

External parties participated in the pilot study in two different ways. At Richland, the public participated in an all-day review session held the last day of the pilot. Time was available to explore the logic behind the funding unit selection and the scoring judgments. At Rocky Flats, external participation took a consultative approach. Rocky Flats staff took the lead in developing the funding units and the alternatives, and made the initial scoring judgments. These judgments were discussed with external parties, and in some cases, the scoring was modified. Although this approach was useful and meaningful for the Rocky Flats pilot study, which had only 2 funding units, it probably would be time-consuming at a site with more than 20 funding units. The conclusion is that general guidance on external participation in the RASS process should be issued to the offices, but each site should choose the form of external participation on the basis of their own situation.

## PILOT STUDY RESULTS

RASS was used to examine 96 funding unit alternatives for 33 funding units included in the pilot study. The maximum WM funding request of \$305.4 million is the sum of the highest target-year funding requests for the 33 alternatives (one from each funding unit). Similarly, the minimum WM funding request of \$115.1 million is the sum of the lowest target-year funding requests for the alternatives, generally the core alternatives.

The pilot study results showed that RASS can be a rich source of information to assist DOE's program and budget analysis process. RASS output provides macro-scale (WM-wide) and micro-scale (funding unit by funding unit) information about human safety and health impacts, compliance

issues, etc., as a function of total WM budget. RASS was used to identify a number of funding allocations over the approximately \$200 million range of WM funding.

One example of RASS output is shown in Fig. 4, which is a plot of total equivalent occupational fatalities versus WM budget. The term equivalent fatalities is used to indicate that morbidity (person-days-lost) is converted to equivalent fatalities by a conversion factor (6,000 person-days-lost is assumed to be equivalent to one fatality). The range on equivalent fatalities is 2.6 to 3.6 and includes impacts for all years included in the RASS pilot study. The y axis is scaled over this range. Occupational equivalent fatalities increase steadily as budgets increase, more waste is handled, and more exposures occur.

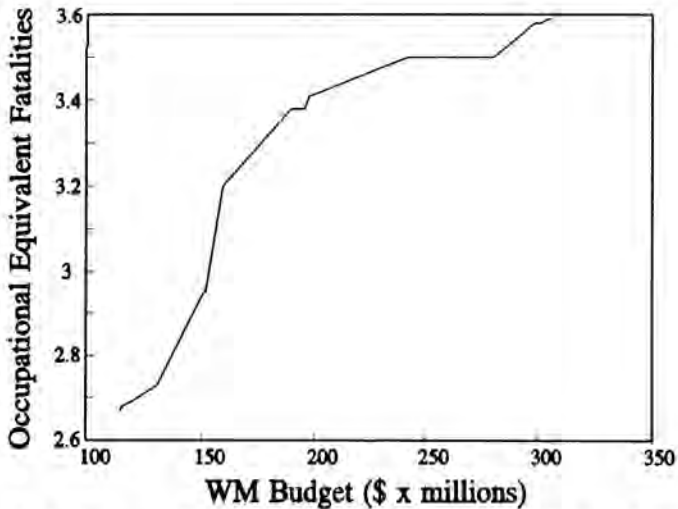


Fig. 4. Occupational equivalent fatalities versus WM budget.

Eight different perspectives on the relative importance of the RASS objectives were obtained and included as part of the pilot study. Although there were differences in the allocations obtained from each perspective, in most cases the allocations were quite similar.

#### LESSONS LEARNED

The pilot study uncovered a number of important issues that needed further attention. Subject areas included:

- Characteristics of funding unit alternatives,
- Safety and health risks,
- Meeting Waste Management needs,
- Specifying funding units,
- Waste types and values, and
- Constructed scale for compliance.

Several different topics were addressed under each of these subject areas. Additional effort will be required to resolve some of the issues before the proposed RASS full-scale test.

#### FUTURE DIRECTIONS FOR RASS

Following review of the pilot study by the three groups, an enhanced RASS design will be prepared for the full-scale test proposed for spring/summer 1993. A decision on the scope and timing of the full-scale test will then be made by DOE.

One particularly important aspect of the full-scale test is the form of participation for regulators and tribal representatives. Field offices, perhaps in consultation with interested parties, could choose whichever of these approaches best suits their circumstances and relationships:

- *Team approach:* State regulators and tribal representatives would work with field office staff to assemble and score the funding unit alternatives. DOE would retain final responsibility to make decisions, but regulators and tribal representatives would contribute to the preliminary discussions about the RASS process (e.g., funding units, funding unit alternatives, and scoring). They would be trained in RASS at the same time that managers are trained and would receive the same guidance.
- *Consultative approach:* Field office staff would do the initial work to assemble and score funding unit alternatives. Regulators, tribal representatives, and field office staff would work together to adjust the alternatives and scores. Regulators and tribal representatives would receive separate training and be invited to some of the manager-level meetings concerning RASS.
- *Review and comment approach:* Field office staff would assemble and score the funding unit alternatives without input from regulators or tribal representatives. Regulators and tribal representatives could receive separate training. State regulators and tribal representatives would receive the results in written form and would provide either written or verbal comments on the funding unit alternatives and scores. Separate from the external parties, field office staff would consider the comments and incorporate them, as appropriate, when revising the alternatives and scores. Regulators and tribal representatives would learn how the comments were considered through either a meeting or a formal written document.

These proposals for public participation will be discussed with external parties at the next national workshop.

#### CONCLUSION

The RASS pilot study conducted at four DOE field offices in summer 1992 was an important step in evaluating the current RASS design. This experience has helped identify improvements that would be beneficial for the proposed full-scale test. Although the pilot study was a small-scale effort compared to the proposed full-scale test, the pilot study will be valuable to DOE in examining the potential usefulness of RASS and future development options for RASS.